48/E1

MISA

WPCP

STOPPING WATER POLLUTION AT ITS SOURCE

MISA

Municipal/Industrial Strategy for Abatement

THIRTY SEVEN MUNICIPAL WATER POLLUTION CONTROL PLANTS

PILOT MONITORING STUDY

VOLUME I

INTERIM REPORT

DECEMBER 1988

Environment Ontario

Jim Bradley
Minister

ISBN 0-7729-4900-X

THIRTY SEVEN
MUNCIPAL WATER POLLUTION CONTROL PLANTS

Pilot Monitoring Study

Volume 1
Interim Report

Report prepared for:
Ontario Ministry of the Environment
Water Resources Branch

Report prepared by:
Canviro Consultants

DECEMBER 1988
Reprinted: November 1989

Copyright: Queen's Printer for Ontario, 1988
This publication may be reproduced for non-commercial purposes
with appropriate attribution.

EXECUTIVE SUMMARY

The Ontario Ministry of the Environment's Municipal Industrial Strategy for Abatement (MISA) Program is aimed at reducing contaminant loadings from direct industrial discharges and from municipal water pollution control plants (WPCPs). The MOE will address the municipal sector by the implementation of a Monitoring Regulation, requiring all Ontario WPCPs to monitor hazardous contaminants (HCs) in effluents and sludges. Subsequently, maximum concentration requirements of HCs in effluents and sludges will be established and a Compliance Regulation will be implemented.

The MOE, Environment Canada and the Municipal Engineers Association (MEA) sponsored this study to provide the information needed to support the development of a cost-effective and practical Monitoring Regulation.

This report is an interim report, summarizing study methodologies and presenting preliminary study findings. A more detailed analysis of the study data to determine factors affecting removal of HCs, and to allow prioritization of effluents and sludges and estimation of HC Loadings from study WPCPs will be presented in the final report.

Thirty-seven Ontario WPCPs were selected for the Pilot Monitoring Study, including 28 secondary treatment plants, 7 primary treatment plants and 2 lagoons. The field monitoring program involved sampling of influent, final effluent and raw and treated sludges for one to two 5 consecutive day periods at each of the study plants. In addition, plant performance parameters were monitored for the 2 weeks prior to sampling and during the sampling period.

Each sample was analyzed for all of the contaminants on a list established by MOE for this study. The monitoring list included 144 organic contaminants, 15 metals and conventional contaminants. Three laboratories contracted by the MOE, and the MOE Laboratory Services Branch (LSB), performed all of the analytical work.

A thorough field QA/QC program involved appropriate cleanliness and sample preservation procedures, duplicate sample collection of all field samples and field blank collection and analyses. Also, a comprehensive laboratory QA/QC program was carried out so that the applicability of each analytical result could be defined. This program involved analysis of method blanks, duplicate samples, field samples spiked with surrogate compounds and distilled water samples spiked with native compounds.

The individual plant data, including background information and analytical results from the sampling program were compiled and are presented in Appendix A (Volume II) of this report.

The analytical results from the sampling program were summarized for all of the plants for each type of sample. Metals were the most prevalently (most WPCPs) and most frequently detected contaminants in all sample types. Only 5 base neutral and acid extractable compounds were ever detected at more than 20 percent of plants for any sample type. Dioxin/furan compounds were detected at a maximum of 27 percent of plants in samples of raw sewage or final effluents (primary, secondary or lagoon) compared to 65 percent of plants for sludges. Approximately the same number (27 to 30) of pesticide/herbicide compounds were detected in raw sewage, secondary effluent and raw and treated sludge samples. The maximum frequency of detection and plant prevalency of pesticide/herbicide compounds was quite large and reasonably uniform for all sample types. The largest number of volatile organic compounds were detected in raw sewage and secondary effluent streams. The maximum frequency of detection of volatile organics compounds ranged from 15 to 55 percent, and the maximum plant prevalency ranged from 32 to 85 percent.

CONTENTS

(KIR18/280)

CONTENTS (cont'd)

TABLES

TABLES (cont'd)

FIGURES

1.0 INTRODUCTION AND PROJECT OBJECTIVES

1.1 Background

The Ontario Government's White Paper entitled, "Municipal-Industrial Strategy for Abatement (MISA)", released in June of 1986 by the Ontario Ministry of the Environment (MOE), outlined a new program to reduce the flow of toxic chemicals to the Province's receiving waters. MISA is aimed at reducing contaminant loadings from direct industrial discharges and from municipal water pollution control plants (WPCPs).

The program for municipal WPCPs will involve two stages. In the first stage, a Monitoring Regulation will be promulgated, requiring all WPCPs in Ontario to monitor HCs in effluents and sludges. In the second stage, maximum concentration requirements of HCs in effluents and sludges will be established and Compliance Regulations will be implemented.

In order that MOE can proceed with the establishment of the Monitoring Regulations, there is a need to determine the nature and incidence of HCs in WPCP effluents and sludges, to examine factors affecting the removal of HCs in wastewater treatment facilities and to evaluate the impact of upstream sanitary sewer users upon the HCs observed in WPCP effluents and sludges.

This study was jointly sponsored by the MOE, Environment Canada and the Municipal Engineers Association (MEA) with a goal of providing the information needed to support the development of a cost-effective and practical Monitoring Regulation.

The following is an interim report summarizing the study methodology used in the 37 WPCP study and presenting preliminary study findings. A more detailed analysis of the study data to determine factors affecting removal of HCs, and to allow prioritization of HCs in effluents and sludges and estimation of HC loadings from the study WPCPs will be presented in the final report.

The report has been organized into two volumes. Volume I has the following contents:

Section 2.0 - Field Program Methodology

This section presents a detailed description of the field program methodology.

Section 3.0 - Analytical Methodology

This section presents details of analytical methods as well as indicating the laboratories participating in the study.

Section 4.0 - WPCP Characteristics

This section outlines the characteristics of all WPCPs in Ontario and compares their characteristics with the 37 WPCPs studied.

Section 5.0 - Results and Analysis

This section presents in summary the preliminary results of the monitoring program.

Volume II of the preliminary report is comprised of individual appendices presenting design, operating and other background data for each WPCP as well as a complete summary of the preliminary results of monitoring.

1.2 Study Objectives

The goal of the Municipal WPCP Pilot Program was to obtain the information necessary to support the development of cost-effective and practical Monitoring Regulation for the municipal sector.

Specific project objectives included:

1. To carry out a well designed and rigorously controlled program of hazardous contaminant sampling of sludge and sewage streams at 37 Ontario WPCPs.

2. To summarize all study findings into a comprehensive project report and to provide a well organized database of HC and other results as well as process and flow measurements in a suitable electronic format.

3. To develop a prioritized list of contaminants observed in the study.

4. To assess the effectiveness of WPCPs in removing HCs and to identify (insofar as possible) the factors influencing removal efficiencies including any 'key' variables that may be employed as indicators of HC removal effectiveness.

5. To estimate the loadings discharged in the sludge and liquid effluents of the study WPCPs.

6. To assess the impact of industrial, residential and commercial sanitary sewer inputs upon the nature and loadings of HCs observed in the raw wastewaters, and sludges.

7. To identify and review major concerns affecting the implementation of the monitoring regulation and to make recommendations as needed to address any anticipated implementation problem areas.

1.3 Scope

The field monitoring program involved sampling of influent, final effluent and raw and treated sludges for one to two 5 consecutive day periods at each of the 37 study plants. Each sample was analyzed for all of the contaminants on a list established by MOE for this study. The monitoring list included 144 organic contaminants, 15 metals and conventional contaminants. A comprehensive QA/QC program was carried out in order to be able to define the applicability of the analytical results.

Three laboratories contracted by MOE (Zenon Environmental Ltd., Mann Testing Ltd. and Enviroclean Ltd.) and MOE Laboratory Services Branch (LSB) carried out all of the analytical work, under the direction of MOE.

The Project Liaison Committee directed the field program and defined the requirements for subsequent analytical data summarization, analysis and report writing.

2.0 FIELD PROGRAM METHODOLOGY

2.1 Selection of WPCPs

The WPCPs for the study were selected by MOE on the basis of the following criteria:

No.	Criteria
1.	All WPCPs which discharged more than 45,000 m^3/day effluent in 1986, regardless of treatment type. There were 16 secondary treatment plants and 7 primary treatment plants that fit this criterion. These WPCPs contributed 69.1 percent of the total flows discharged by the 406 plants in Ontario in 1986.
2.	Secondary WPCPs that were previously monitored by the Upper Great Lakes Connecting Channels (UGLCC) study in the summer of 1986. Eleven plants were monitored by UGLCC(Ref.1). Three of the 11 plants were already selected under Criterion 1. Consequently, only 5 additional secondary plants with an average daily flow in 1986 of less than 45,000 m^3/day were selected under Criterion 2 alone. Three plants (Chatham secondary WPCP, Amhurstburg and Point Edward, primary WPCPs) were not remonitored in this study.
3.	Small secondary treatment plants with flows less than 20,000 m^3/d which produced effluent quality typical of the effluent quality achieved in Ontario by well-operated secondary WPCPs were also selected. "Typical" effluent quality was defined as effluent BOD and TSS concentrations between 8 and 15 mg/L, and total phosphorus (TP) concentrations between 0.7 and 1.0 mg/L. Plant location was also considered in plant selection. It was more desirable in terms of economics and logistics, to sample at WPCPs that were in proximity to those selected in Criteria 1 and 2. Seven plants were selected under Criterion 3.
4.	Two lagoons were also selected for monitoring. Lindsay is served by the largest lagoon in Ontario. Niagara-on-the-Lake has a medium sized lagoon treatment facility.

In total, 37 WPCPs were selected by the above criteria. Table 2-1 presents a list of these plants indicating the criteria under which they were selected. Figure 2-1 presents a map showing the location of each WPCP.

Table 2-1
ONTARIO WPCPs SELECTED FOR THE MONITORING PROGRAM

Criteria	WPCP	Treatment Type
1. 1986 Average Daily Flow >45,000 m³/d	Brantford	Secondary
	Burlington (Skyway)	Secondary
	Cornwall	Primary
	Guelph	Secondary - Tertiary
	Hamilton	Secondary
	Kingston City	Primary
	Kitchener	Secondary
	London (Greenway)	Secondary
	Mississauga (Clarkson)	Secondary
	Mississauga (Lakeview)	Secondary
	Niagara Falls (Stamford)	Secondary
	Ottawa (Green Cr.)	Primary
	Pickering (Duffin Cr.)	Secondary
	Peterborough	Secondary
	Sarnia	Primary
	Sault Ste.Marie (East)	Primary
	Sudbury	Secondary
	Thunder Bay	Primary
	Toronto (Highland Cr.)	Secondary
	Toronto (Humber)	Secondary
	Toronto (Main)	Secondary
	Waterloo	Secondary
	Windsor (Westerly)	Primary
2. UGLCC and 1986 Average Daily Flow <45,000 m³/d	Belle River (Maidstone)	Secondary
	Moore (Corunna)	Secondary
	Sault Ste.Marie (West)	Secondary
	Wallaceburg	Secondary
	Windsor (Little River)	Secondary
3. Small Secondary WPCPs 1986 Average Daily Flow <20,000 m³/d	Grimsby (Baker Road)	Secondary
	Kingston Township	Secondary
	London (Pottersburg)	Secondary
	Oakville (South East)	Secondary
	Paris	Secondary
	Toronto (North)	Secondary
	Whitby (Pringle Creek 1)	Secondary
4. Lagoons	Lindsay	Lagoon
	Niagara-on-the-Lake	Lagoon

Figure 2-1

GEOGRAPHIC LOCATIONS OF PLANTS INCLUDED IN THE 37 WPCP STUDY

2.2 Selection of Target Compounds

The listing of target monitoring parameters for the entirety of the MISA program is presently embodied in the Environmental Monitoring Priority Pollutant List (EMPPL) (Ref. 2). At the time the 37 WPCP study was initiated the EMPPL listing was not as yet formulated and consequently an alternative but nonetheless comprehensive listing of contaminants was identified.

The organic contaminant list used in the present study includes all of the 126 organic contaminants monitored in the U.S. Environmental Protection Agency's (USEPA) Priority Pollutant List (PPL), established in 1972 (Ref. 3). The list also includes additional chlorinated pesticides, nitrogen phosphorus herbicides and phenoxy acid herbicides.

The organic contaminants that were monitored are presented in Table 2-2(a). The list includes 42 volatile organic compounds, 57 base neutral and acid extractable compounds, 35 pesticides and herbicides, and 10 dioxin furans (PCDD/PCDF) compounds. In total there were 144 organic contaminants monitored.

Fifteen metals were also monitored during the study, which are listed in Table 2-2(b). This list includes all of the metals presently regulated in Ontario in sludges utilized on agricultural land. A number of conventional contaminants, cyanide and total phenolics were monitored during the study. These contaminants were selected as general plant performance indicators. The list of conventional contaminants is presented in Table 2-2(c).

Table 2-3 presents those HCs included on the EMPPL but not monitored in this study. This list consists of 80 contaminants.

The organic contaminant list selected for this study is the same as the one used for monitoring by the City of Metropolitan Toronto at their 4 WPCPs in 1984, 1985 and 1986. This list was chosen because the MOE were confident that these contaminants can be satisfactorily monitored and that a long-term data base would be available for the 4 Toronto plants.

2.3 Monitoring Program

The sampling program at the 37 selected plants began in January 1987 and was completed in July 1987. In general, each monitoring period involved 2 weeks of pre-monitoring of plant performance and 5 days of sampling. Seventeen plants were monitored for two periods and 20 were monitored for one period only.

Table 2-2(a)
ORGANIC CONTAMINANTS MONITORED IN THE STUDY

Base Neutral and Acid Extractable Compounds	Dioxins/Furans	Pesticides and Herbicides	Volatile Organic Compounds
2,4,5-Trichlorophenol	Tetrachlorodibenzodioxins	Toxaphene*	1,1,1-Trichloroethane*
2,4,6-Trichlorophenol	Tetrachlorodibenzofurans	Total PCB	1,1,2,2-Tetrachloroethane
2,4-Dichlorophenol	Pentachlorodibenzodioxins	Strobane*	1,1,2-Trichloroethane
2,4-Dimethyl phenol	Pentachlorodibenzofurans	Silvex*	1,1-Dichloroethene
2,4-Dinitrotoluene	Hexachlorodibenzodioxins	PP-DDT*	1,2-Dichlorobenzene
2,4-Dinitro-o-cresol	Hexachlorodibenzafurans	PP-DDE*	1,2-Dichloroethane
2,6-Dinitrotoluene	Heptachlorodibenzodioxins	PP-DDD*	1,2-Dichloropropane
2 Hydroxy-toluene (O-Cresol)	Heptachlorodibenzofurans	Photomirex*	1,3-Dichlorobenzene
2-Chloronaphthalene	Octachlorodibenzodioxin	PCNB*	1,4-Dichlorobenzene
2-Chlorophenol	Octachlorodibenzofuran	Oxychlordane*	1-Octene*
2-Nitrophenol*		Mirex*	2-Chloroethylvinyl ether*
3 Hydroxy-toluene (m-Cresol)		Methoxychlor*	3-Chloro-1-propene*
4 Hydroxy-toluene (P-Cresol)		Hexacloroethane	3-Chloro-toluene*
4-Bromophenyl phenyl ether		Hexachlorocyclopentadiene	Acrolein
4-Chlorophenyl phenyl ether		Hexachlorobutadiene	Acrylonitrile
9H Fluorene		Heptachlor Epoxide*	Benzene
Acenapthene		Heptachlor*	Bromodichlorobenzene*
Acenapthylene		HCB	Bromodichloromethane
Alpha-naphthylamine*		Gamma-Chlordane*	Bromoethane
Ametryn* (PH)		Gamma-BHC8	Bromoform
Anthracene		Eldrin Aldehyde*	Carbon tetrachloride
Atrazine* (PH)		Eldrin*	Chlorobenzene
Benzo (A) anthracene		Endosulfan Sulphate*	Chloroethane*
Benzo (A) pyrene		Dieldrin*	Chloroform
Benzo (B) fluoranthene		Delta-BHC*	Chloromethane
Benzo (K) fluoranthene		Captan*	cis-1,3-Dichloropropene
Beta-napthylamine*		Beta-Endosulfan*	cis-1,2-Dichloroethylene*
Biphenyl		Beta-BHC*	Dibromochloromethane
bis(2-Chloro ethoxy) methane		Alpha-Endosulfan*	Dichlorodifluoromethane*
bis(2-Chloro ethyl) ether		Alpha-Chlordane*	Diethyl ether*
bis(2-Chloroispropyl) ether		Alpha-BHC*	Ethylbenzene
bis(2-ethyl hexyl) phthalate		Aldrin*	Hexane*
Butyl benzyl phthalate		2,4-Dichlorophenoxyacetic acid (2,4-D)*	Hexanol*
Chrysene			Methylene chloride
Diazinon* (PH)		2,4-5Trichlorophenoxy-acetic acid (2,4,5-T)*	Styrene
Dibenzo (AH) anthracene			Tetrachloroethene
Dicloran* (PH)			Toluene
Diethyl phthalate*		1,2,4-Trichlorobenzene	Trans-1,3-Dichloropropene
Dimethyl phthalate*			Trichloroethene
Diphenyl ether			Trichloroflouromethane
Di-n-butyl phthalate			Vinyl bromide*
Di-n-octyl phthalate			Vinyl chloride
Fluoranthene			
Indeno (123-CD) pyrene			
Malathion* (PH)			
Naphthalene			
Nitrobenzene*			
N-Nitroso Diphenylamine			
N-Nitroso-di-n-propyl-amine			
Parathion ethyl* (PH)			
Parathion methyl* (PH)			
Pentachlorophenol			
Phenanthrene			
Phenol			
Pyrene			
P-chloro-M-cresol*			
Tri-n-tolyl phosphate			

Notes:

* Contaminants not included in EMPPL (Ref. 2)

(PH) Pesticide/Herbicide compound grouped with Base neutral and acid extractable compounds for analyses

Table 2-2(b)
LIST OF METALS MONITORED IN THE STUDY

Priority Metals: (Regulated by MOE in sludge applied to agricultural land)	Arsenic	As
	Cadmium	Cd
	Chromium	Cr
	Cobalt	Co
	Copper	Cu
	Mercury	Mg
	Molybdenum	Mo
	Nickel	Ni
	Lead	Pb
	Selenium	Se
	Zinc	Zn
Other Metals:	Aluminum	Al
	Beryllium	Be
	Silver	Si
	Strontium	St

Table 2-2(c)
CONVENTIONAL CONTAMINANTS MONITORED IN THE STUDY

Raw Wastewater & Effluent Streams	Sludges
pH	pH
Biochemical Oxygen Demand (BOD_5)	Chemical Oxygen Demand (COD)
Chemical Oxygen Demand (COD)	Nitrites (NO_2)
Dissolved Organic Carbon (DOC)	Nitrates (NO_3)
Total Suspended Solids (TSS)	Ammonia (NH_3)
Total Volatile Suspended Solids (VSS)	
Filtered Nitrite (NO_2)	Total Kjeldhal Nitrogen (TKN)
Filtered Nitrates (NO_3)	Total Phosphorus (TP)
Filtered Ammonia (NH_3)	Total Solids (TS)
Total Kjeldhal Nitrogen (TKN)	Total Volatile Solids (VS)
Total Phosphorus (TP)	Total Phenolics (4AAP)
Turbidity	Cyanide
Total Phenolics (4AAP)	
Cyanide (Total)	

Table 2-3
EMPPL (Ref. 2) ORGANIC CONTAMINANTS NOT MONITORED IN THE PRESENT STUDY

1,1,3,3-Tetrachloroacetone
1,1,3-Trichloroacetone
1,2,3,4-Tetrachlorobenzene
1,2,3,5-Tetrachlorobenzene
1,2,3-Trichlorobenzene
1,2,4,5-Tetrachlorobenzene
1,3-Butadiene
1,4-Dioxane
1-Chloronaphthalene
1-Methylnaphthalene
1-Nitronaphthalene
2,3,4,5-Tetrachlorophenol
2,3,4,6-Tetrachlorophenol
2,3,4-Trichlorophenol
2,3,5,6-Tetrachlorophenol
2,3,5-Trichlorophenol
2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,4,5-Trichlorotoluene
2,6-Di-t-butyl-4-methylphenol
2-Hydroxybiphenyl
2-Methylnaphthalene
2-Nitroapththalene
3,3 Dichlorobenzidene
4,6-Dinitro-o-cresol
4-Aminoazobenzene
4-Chloro3-methylphenol
4-Hydroxybiphenyl
Abietic Acid
Acenaphthene, 5-nitro
Acridine
Aniline
Benzaldehyde
Benzeneacetonitrile
Benzidine
Benzyl alcohol
Bis(2-chloroethyl)ether
Bromomethane
Butanal
Camphene
Chlorodehydroabietic acid
Chromium (hexavalent)
Dehydroabietic acid
Dimethyl disulphide
Diphenylamine
Ethylene dibromide
Ethylene thiourea
Eugenol
Formaldehyde
Hydrazine
Hydroxycyclohexane (Cyclohexanol)
Indole
Isopimaric
Levopimaric acid
Limonene
Mercapto benzothiazole
Methyl ethyl ketone
Methyl styrene
Neoabietic acid
N-Methylformamide
N-Nitrosodimethylamine
Octachlorostyrene
Oil and grease
Oleic Acid
Pentachlorobenzene
Perylene
Pimaric acid
Specific conductance
Sulphide
Tetrachloroacetone
Tetrachloroguolocal
Tetraethyl lead
Tetra-alkyl lead (Total)
Thiourea
Total organic carbon (TOC)
Trichloroguolacol
Triethyl lead
Trimethylbenzenes (1,2,3 isomers)
Trimethylnaphthalene
Tri-alkyl lead (Total)
Tri-n-Butylphosphate

During the 5 day sampling period, 24-hour composite samples of raw sewage and final effluent (primary, secondary or lagoon) were collected daily. Also, 5-day composite samples of raw sludge and treated sludge were collected.

2.3.1 WPCP Sampling Schedule

The sampling schedule was organized into two separate survey programs. The "winter" program began on 19 January 1987 and continued until 30 March 1987, involving sampling at 25 WPCPs. The "summer" program occurred between 20 April 1987 and 26 July 1987 and included 29 WPCPs. Seventeen of the WPCPs were sampled in both programs, and the remaining 20 were sampled in only one program. Table 2-4 presents the plants sampled in each program.

It should be noted that the labels "winter" and "summer" were used throughout the study to describe the sampling schedules, however, did not necessarily imply a significant difference in weather temperature or operating conditions between the winter and summer programs.

The study requirements outlined that the monitoring of WPCPs take place during periods of "typical" operation. Operation was considered "typical" if the operating conditions were within a normal range expected for the particular plant. This encompassed a wide range of operational conditions, including minor process upsets and equipment malfunction.

Due to limited time and resources, it was not feasible to monitor plants during periods of exceptional circumstances. Therefore, plant monitoring during periods of process shut downs, process changeovers, large industrial spills and major upsets was avoided, where possible.

In general treatment plants were sampled for 5 consecutive days. Four plants were sampled for an extended 7 day period during the summer program. Specifically, they were: Kitchener WPCP, Ottawa (Green Creek) WPCP, Mississauga (Clarkson) WPCP and Toronto (Highland Creek) WPCP. Tables 2-5 and 2-6 respectively present the winter and summer sampling program schedules.

2.3.2 Pre-Monitoring Site Inspections

Prior to the monitoring at each of the 37 WPCPs in the present study, a senior CANVIRO engineer accompanied by a MOE staff member visited the site. The purposes of this initial visit were to define the sampling sites and to arrange for collection of design information, plant operating records and photographs of the site.

Table 2-4
WPCP SAMPLING PROGRAMS

Plant	Code	Winter	Summer
Belle River (Maidstone)	MA	X	
Brantford	BR	X	X
Burlington (Skyway)	BU	X	X
Cornwall	CO	X	X
Grimsby (Baker Rd.)	GR		X
Guelph	GU	X	X
Hamilton (Woodward)	HA	X	X
Kingston City	KC		X
Kingston Township	KT		X
Kitchener	KI	X	X
Lindsay	LI		X
London (Greenway)	LG	X	X
London (Pottersburg)	LP	X	X
Mississauga (Clarkson)	MC	X	X
Mississauga (Lakeview)	ML	X	X
Moore (Corunna)	CR	X	
Niagara Falls (Stamford)	NF	X	X
Niagara-on-the-Lake	NL		X
Oakville (SE)	OA		X
Paris	PA		X
Peterborough	PT	X	X
Pickering (Duffin Creek)	PD	X	X
Sarnia	SA	X	
Sudbury	SU		X
Sault Ste. Marie (East/Old)	SE	X	
Sault Ste. Marie (West/New)	SW	X	
Thunder Bay	TB		X
Toronto (Highland Creek)	TS	X	X
Toronto (Humber)	TH	X	X
Toronto (Main)	TM	X	X
Toronto (North)	TN		X
Wallaceburg	WA	X	
Waterloo	WT	X	X
Whitby (Pringle Creek #1)	WP		X
Windsor (Little River)	WL	X	
Windsor (Westerly)	WW	X	
Ottawa (Green Creek)	OT		X

Table 2-5
WINTER SAMPLING SCHEDULE

Plant	Sampling Dates
Kitchener	Jan 19 - Jan 23
Waterloo	Jan 19 - Jan 23
Burlington	Jan 19 - Jan 23
Toronto (Main)	Jan 26 - Jan 30
Mississauga (Clarkson)	Mar 2 - Mar 6
Mississauga (Lakeview)	Mar 2 - Mar 6
Toronto (Humber)	Feb 9 - Feb 13
London (Greenway)	Feb 16 - Feb 20
London (Pottersburg)	Feb 16 - Feb 20
Windsor (Little River)	Feb 16 - Feb 20
Windsor (Westerly)	Feb 16 - Feb 20
Hamilton (Woodward)	Feb 23 - Feb 27
Toronto (Highland Creek)	Mar 16 - Mar 20
Sault Ste. Marie (West)	Mar 16 - Mar 20
Sault Ste. Marie (East)	Mar 16 - Mar 20
Peterborough	Mar 9 - Mar 13
Sarnia	Feb 2 - Feb 6
Moore (Corunna)	Feb 2 - Feb 6
Wallaceburg	Feb 2 - Feb 6
Belle River (Maidstone)	Feb 2 - Feb 6
Brantford	Mar 9 - Mar 13
Pickering (Duffin Creek)	Mar 30 - Feb 3
Cornwall	Mar 30 - Feb 3
Guelph	Mar 27 - Mar 27
Niagara Falls (Stamford)	Mar 23 - Mar 27

Table 2-6
SUMMER SAMPLING SCHEDULE

Plant	Sampling Dates
Peterborough	Apr 20 - Apr 24
Lindsay	Apr 20 - Apr 24
Grimsby (Baker Rd.)	Apr 20 - Apr 24
Cornwall	May 4 - May 8
Guelph	May 4 - May 8
Paris	May 11 - May 15
Sudbury	May 11 - May 15
Pickering (Duffin Creek)	May 18 - May 22
Kingston City	May 18 - May 22
Kingston Township	May 18 - May 22
Whitby (Pringle Creek #1)	May 18 - May 22
Niagara Falls (Stamford)	May 25 - May 29
Niagara-on-the-Lake	May 25 - May 29
Thunder Bay	Jun 1 - Jun 5
Toronto (North)	Jun 8 - Jun 12
Oakville (SE)	Jun 8 - Jun 12
Toronto (Main)	Jun 15 - Jun 19
Mississauga (Clarkson)*	Jun 22 - Jun 26
Burlington (Skyway)	Jun 22 - Jun 26
Toronto (Highland Creek)*	Jun 29 - Jul 5
Hamilton (Woodward)	Jun 29 - Jul 3
London (Greenway)	Jul 6 - Jul 10
London (Pottersburg)	Jul 6 - Jul 10
Brantford	Jul 6 - Jul 10
Mississauga (Lakeview)	Jul 13 - Jul 17
Waterloo	Jul 20 - Jul 24
Ottawa (Green Creek)*	Jul 20 - Jul 26
Toronto (Humber)	Jul 20 - Jul 24
Kitchener*	Jul 20 - Jul 26

* Plants sampled for 7 days

The evaluation of the sampling site involved the selection of suitable locations for the sampling equipment and identification and resolution of sampling difficulties. The plant flow monitoring equipment (sewage and sludge meters) were reviewed to assess the equipment accuracy and the ability to flow proportion samples. In addition, the monitoring program was discussed with the plant staff for the purpose of locating field team equipment (refrigerators, monitoring equipment, etc.) and to ensure a full understanding of project requirements.

During the initial visit, arrangements were made to obtain historical performance data for each plant, plant operating record sheets, and plant design reports.

2.3.3 Background Monitoring

In order to ensure that the HC data obtained at the plants would be collected under conditions that were representative of typical plant operation, a two-week presampling process monitoring period was established. After the initial site visit, any limitations in the routine monitoring program were identified. Supplemental monitoring requirements were then determined for any additional process information for the two weeks prior to the sampling period.

In order to define plant performance during the premonitoring period, data was collected for influent and effluent conventional contaminants (BOD_5, TSS, TP, TKN, NH_3-N). At some plants, these parameters were not routinely monitored. It was therefore arranged that a sample be collected by WPCP staff at least once per week and submitted to MOE for analysis.

All of the available performance monitoring information was summarized on a spreadsheet. Figure 2-2 presents an example spreadsheet and shows monitored and derived data.

In certain instances, additional data not routinely collected was obtained by plant staff during the pre-monitoring and sampling period. This information included waste sludge rates, phosphorus removal chemical dosage, raw sludge volumes, digested sludge volumes, etc. The operation of the plant was evaluated for the study period based on discussions with plant operating staff, the background data and all pre-monitoring data.

2.3.4 Sampling Methodologies

2.3.4.1 Sampling Locations

Table 2-7 presents a summary of the sampling locations at each plant.

Figure 2-2
EXAMPLE OPERATIONAL EVALUATION SPREADSHEET

OPERATIONAL EVALUATION FOR: "E X A M P L E" W P C P

TREATMENT FACILITY: Secondary
PERIOD ENDING: Feb. 20, 1987
SAMPLING SEASON: Winter (Cold Weather)
DESIGN AVG FLOW: 36,320 m3/d

PARAMETER	PRE-SAMPLING PERIOD							PRE-SAMPLING PERIOD							SAMPLING PERIOD						
	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 6	DAY 7	DAY 8	DAY 9	DAY 10	DAY 11	DAY 12	DAY 13	DAY 14	DAY 15	DAY 16	DAY 17	DAY 18	DAY 19	DAY 20	DAY 21
RAW SEWAGE FLOW	43,500	40,800	36,300	35,400	35,800	39,000	41,700	34,000	34,900	34,000	34,000	41,700	31,300	27,600	27,600	28,100	28,100	29,500	29,000		
% of Design Flow	119.77%	112.33%	99.94%	97.47%	98.57%	107.38%	114.81%	93.61%	96.09%	93.61%	93.61%	114.81%	86.18%	75.99%	75.99%	77.37%	77.37%	81.22%	79.85%		
Influent BOD (mg/L)	171.0	210.0	164.0	149.0	113.0	124.0	140.0	145.0	148.0	107.0	172.0	226.0	230.0	145.0	173.0	159.0	125.0	219.0	107.0		
Primary BOD (mg/L)																					
Secondary BOD (mg/L)	8.0	5.0	5.0	11.0	4.0	3.0	3.0	7.0	6.0	4.0	3.0	5.0	4.0	21.0	27.0	27.0	27.0	3.0	28.0		
% PRIMARY REMOVAL																					
% SECONDARY REMOVAL	95.3	97.6	97.0	92.6	96.5	97.6	97.9	95.2	95.9	96.3	98.3	97.8	98.3	85.5	84.4	83.0	78.4	98.6	73.8		
Influent SS (mg/L)	244.0	290.0	192.0	192.0	151.0	150.0	182.0	171.0	174.0	128.0	172.0	228.0	216.0	214.0	135.0	140.0	124.0	217.0	106.0		
Primary SS (mg/L)																					
Secondary SS (mg/L)	11.0	7.0	8.0	13.0	11.0	7.0	8.0	16.0	12.0	11.0	8.0	14.0	7.0	16.0	6.0	8.0	9.0	16.0	9.0		
% PRIMARY REMOVAL																					
% SECONDARY REMOVAL	95.5	97.6	95.8	93.2	92.7	95.3	95.6	90.6	93.1	91.4	95.3	93.9	96.8	92.5	95.6	94.3	92.7	92.6	91.5		
Influent NH4 (mg/L)	14.2	12.8					5.4	6.8	6.8						15.7	18.5					
Primary NH4 (mg/L)																					
Secondary NH4 (mg/L)	1.0	0.6					1.3	0.8	1.4						2.7	2.0					
% PRIMARY REMOVAL																					
% SECONDARY REMOVAL	93.2	95.3					75.9	88.4	79.4						82.8	89.2					
Influent TKN (mg/L)	25.3	23.2					14.0	11.7	12.7						27.6	32.6					
Primary TKN (mg/L)																					
Secondary TKN (mg/L)	2.4	2.4					1.3	2.6	1.7						9.0	14.3					
% PRIMARY REMOVAL																					
% SECONDARY REMOVAL	90.5	89.7					90.7	77.8	86.1						67.4	56.1					
Influent Total P (mg/L)	6.90	6.20	4.60	5.10	4.60	4.00	3.70	4.60	5.00	4.30	5.50	8.00	8.50	5.10	7.40	6.70	5.20	7.20	6.40		
Primary Total P (mg/L)																					
Secondary Total P (mg/L)	0.50	0.19	0.34	0.47	0.46	0.30	0.37	1.50	0.38	0.46	0.34	0.64	0.51	1.10	0.80	0.99	0.37	0.35	0.45		
% PRIMARY REMOVAL																					
% SECONDARY REMOVAL	92.8	96.9	92.6	91.8	90.0	92.5	91.4	67.4	92.4	89.3	93.8	92.0	94.0	78.4	89.2	84.0	92.9	95.1	93.0		

Table 2-7

SUMMARY OF SAMPLING LOCATIONS AT THE STUDY WPCP's

Plant	Raw Sewage	Primary Effluent	Secondary Effluent	Tertiary Effluent	Raw Sludge	Waste (Treated) Sludge	Recycle to Raw Sewage Stream
	Number of Sampling Locations						
Tertiary							
Guelph	1	-	1	1	1	AND/DW-1	-
Secondary							
Belle River (Maidstone)	1	-	1	-	1	AD-1	-
Brantford	1	-	1	-	2	AND-1	-
Burlington (Skyway)	1	-	1	-	1	AND-1	-
Grimsby (Baker Road)	1	-	1	-	1	AND-1	-
Hamilton	1	-	1	-	1	AND/DW-1	1
Kingston TWP	1	-	1	-	1	AND-1	1
Kitchener	1	-	1	-	1	AND-1	-
London (Greenway)	1	-	1	-	WAS-1/PRIM-1	DW-1	-
London (Pottersburg)	1	-	1	-	1	-	-
Mississauga (Clarkson)	1	-	1	-	2	COTH/AND-1	-
Mississauga (Lakeview)	2	-	3	-	1	DW/BL/TC-1	-
							-
Moore (Corunna)	1	-	1	-	1(RAS)	HT-1	-
Niagara Falls (Stamford)	1	-	1	-	1(PRIM)1(RBC)	AND-1	-
Oakville (SE)	1	-	1	-	1	AND-1	-
Paris	1	-	1	-	1	AD/TH/HT-1	-
Peterborough	1	-	1	-	1	AND-1	-
Pickering (Duffin Creek)	1	-	1	-	1	AND/DW-1	-
Sault Ste. Marie (West)	1	-	1	-	1	HT/DW-1	1

Notes:

AND - Anaerobically Digested
AD - Aerobically Digested
DW - Dewatered
INC - Incinerated
COTH - Co-thickened in Primary Clarifiers
HT - Heat Treated
THO - Thermally Oxidated
WAS - Waste Activated Sludge - no treatment
TC - Thermally Conditioned
TH - Thickened
HT - Holding Tank - Supernatant Decanted
GR - Ground
RAS - Return Activated Sludge
PRIM - Primary Sludge
RBC - Rotating Biological Contacter Sludge
HEAT - Heat Treatment

(KIR18/282W)

Table 2-7
Continued

Plant	Raw Sewage	Primary Effluent	Secondary Effluent	Tertiary Effluent	Raw Sludge	Waste (Treated) Sludge	Recycle to Raw Sewage Stream
	Number of Sampling Locations						
Sudbury	1	-	1	-	-	HT-1	-
Toronto (Highland Creek)	1	-	1	-	1	COTH/AND/GR/HEAT/DW-1	-
Toronto (Humber)	1	-	1	-	PRIM-1/TH-1	TH/AND-1	2
Toronto (Main)	3	-	1	-	PRIM-1/TH-1	TH/AND/THO/DW-1	
Toronto (North)	1	-	1	-	1	AND/DW-1	-
Waterloo	1	-	2	-	2	AND-2	-
Wallaceburg	1	-	1	-	1	AND/DW-1	-
Whitby (Pringle Cr #1)	2	-	1	-	1	AND-1	1
Windsor (Little River)	1	-	1	-	1	DW-1	1
Primary							
Cornwall	1	1	-	-	1	AND/DW-1	-
Kingston (City)	1	1	-	-	1	AND-1	-
Ottawa (Green Ck)	1	1	-	-	1	AND-1	2
Sarnia	1	1	-	-	1	AND-1	1
Sault Ste. Marie (East)	2	1	-	-	1	-	-
Thunder Bay	1	1	-	-	2	AND-1	-
Windsor (Westerly)	1	1	-	-	1	DW-1	1
Lagoon							
Lindsay	1	2	-	-	-	-	-
Niagara-on-the-Lake	1	1	-	-	-	-	-

Notes:

AND - Anaerobically Digested
AD - Aerobically Digested
DW - Dewatered
INC - Incinerated
COTH - Co-thickened in Primary Clarifiers
HT - Heat Treated
THO - Thermally Oxidated
WAS - Waste Activated Sludge - no treatment
TC - Thermally Conditioned
TH - Thickened
HT - Holding Tank - Supernatant Decanted
GR - Ground
RAS - Return Activated Sludge
PRIM - Primary Sludge
RBC - Rotating Biological Contacter Sludge
HEAT - Heat Treatment

(KIR18/282W)

In general, raw sewage was sampled at a point at, or past, the grit removal area which provided good mixing characteristics. If there was aeration at the grit removal area, samples for volatile organic compounds only were collected upstream of this point.

At nine plants it was not possible to obtain a raw sewage sample at a point in the plant before an internal recycle (eg. digester supernatant, waste activated sludge etc.) entered the stream. In these cases, it was also necessary to collect a recycle stream sample so that the recycle contribution to the combined stream in terms of flows and contaminants, could be subtracted to obtain the actual raw wastewater characteristics.

Final effluent streams at all WPCPs except Mississauga (Lakeview) were sampled at a point beyond the point of chlorine addition. Due to logistics, at Lakeview, the effluent sample was taken prior to chlorination and manually chlorinated by the sampling team (subsection 2.3.4.3).

Sampling of raw sludges took place at one or more locations at each plant, depending on the configuration. Samples were only taken during operation of the sludge pumps. Typically, the treatment plants had multiple sumps from where raw sludge could be drawn. In the more complex cases, it was not practical to sample all of the locations each day. In these cases, a sample routine was determined which would allow all locations to be sampled on a regular basis over the 5 day study period. If waste activated sludge was sampled as a separate component of the raw sludge sample it was aliquoted on a flow weighted basis.

Treated sludges were either digested or digested and dewatered. For digested sludges, samples were taken from each digester in service and composited into one treated sludge sample. In plants with dewatering operations, the sludge cake was sampled.

2.3.4.2 Sample Collection Procedures

Raw sewage, final effluent (primary, secondary, lagoon and tertiary) and recycle streams were collected using the following methods:

Sampling Method	Analyses
24-hour flow proportioned composites	Conventionals, metals, cyanide, base-neutral and acid extractable compounds and pesticides and herbicides
5-day composite samples	Dioxin-furan compounds
Grab samples (3 per 24 hours)	Volatile organic compounds

The 24-hour flow proportioned composite samples were collected using one of three techniques, depending on the logistics of the sampling point. These included:

- o Automatic samplers withdrew one individual aliquot each hour. All of the aliquots were manually composited on a flow-proportioned basis at the end of each 24-hour period.
- o Automatic samplers were interfaced with the plant flow recorders so that flow weighted hourly aliquot volumes were added directly into one composite container.
- o Hourly aliquots were grab sampled and composited manually on a flow proportioned basis at the end of each 24-hour period.

For dioxin/furan analyses, flow proportioned aliquots were collected 3 times each day at least 2 hours apart and combined to form 5 day composite samples. Each aliquot was poured directly into the 5-day composite container.

Grab samples for volatile organic compound analyses were collected 3 times per day at least 2 hours apart. The equal volume samples were combined into daily composite samples at the analytical laboratory.

Raw and treated sludge samples collected for all analyses were 5-day flow proportioned composite samples. A minimum of three grab aliquots were collected each day, at least 2 hours apart. There were two methods of making up sludge samples as follows:

- o Individual aliquots were stored separately and combined flow proportionally at the end of the 5-day period to form one 5-day composite sample.
- o Individual flow proportioned aliquots were added directly to the 5-day composite container. This method was only used if the sludge flow was reasonably constant from day to day.

2.3.4.3 Sampling Handling Procotol

In order to ensure the integrity of sample results, a number of cleanliness, security and preservation procedures were carried out in the field.

All of the field equipment coming into contact with the sample was washed with methanol and rinsed with organic free distilled water prior to sampling. When sampling liquid streams, the equipment was also pre-rinsed with the stream

before the sample was taken. Equipment material was either glass, stainless steel, teflon or surgical graded silicon rubber. All equipment was site specific.

For security against breakages in transport or at the laboratory, all samples were collected in duplicate.

Tables 2-8 and 2-9 present the preservation methods used for liquid and sludge samples respectively. In addition to bottle specific preservation methods dependent on the nature of the analyses, all bottles were stored at 4°C in the field and during transport.

Table 2-8
INFLUENT, EFFLUENT AND RECYCLE SAMPLE PRESERVATION

Sample Group	Analysis	# of Samples	Bottle(2)	Preservation(1)
24 hr composite (Automatic or manual)	Base Neutral and Acid Extractable	2/day	1L (3P)	4°C
	Pesticides/Herbicides	2/day	1L (3P)	4°C
	ICAP	2/day	500 mL (20)	HNO_3 + 4°C
	Mercury	2/day	250 mL (8c)	HNO_3 + K_2CrO_7 + 4°C
	Conventionals	2/day	1 L (3)	4°C
	Phenolics	2/day	250 mL (8p)	$CuSO_4$ + H_2PO_4 + 4°C
	Cyanide	2/day	500 mL (20)	NaOH + 4°C
5 day composite	Dioxins/Furans	2/wk	1L (3p)	4°C
Grabs	Volatile Organics	6/day	50 mL vials	4°C

Notes: (1) Sodium Thiosulphate was added to all effluent samples
(2) MOE bottle description code

Table 2-9
SLUDGE SAMPLE COLLECTION AND PREPARATION

Sample Type	Analysis	# of Samples	Bottle*	Preservation
Sludges (Raw & Treated)	Volatile Organics	2/wk	250 mL (5p)	Methanol 4°C
	Base Neutral & Acid Extractable	2/wk	250 mL (5p)	4°C
	Pesticides & Herbicides	2/wk	250 mL (5p)	4°C
	Dioxins/Furans	2/wk	250 mL (20)	4°C
	ICAP, Mercury, Cyanide	2/wk	500 mL (20)	4°C
	Conventionals	2/wk	250 mL (5)	4°C
	Phenolics	2/wk	250 mL (5)	4°C

* - MOE Bottle Description Code

In addition to the above procedures, sodium thiosulphate ($Na_2S_2O_3$) was added to all final effluent samples to neutralize the chlorine residual. The sodium thiosulphate was added to final effluent sample containers prior to sampling each day.

At one plant (Mississauga (Lakeview)), it was not possible to obtain a chlorinated effluent sample, and non-chlorinated effluent was sampled. In this particular case, the sample was dosed with a concentrated sodium hypochlorite solution to provide a chlorine concentration in the sample equal to the concentration in the chlorinated plant effluent, and mixed slowly for a time equal to the contact time at the plant. The sample was subsequently neutralized with sodium thiosulphate.

2.3.5 Documentation of Field Program

Field sampling personnel were responsible for maintaining two types of records:

- o Process information
- o Sample submissions

Any process information that related to sampled streams was recorded daily. Also, a wide range of sample submission information was recorded in field logs. Records maintained at each treatment plant depended on the type of processes being sampled. A list of typical field record information documented for each sample stream is listed in Table 2-10.

Table 2-10
FIELD RECORD INFORMATION

Information	Stream				
	Influent	Effluent	Recycle	Raw Sludge	Treated Sludge
Hourly Flows	X	X	X		
Daily Flows	X	X	X	X	X
Pump Times			X	X	X
Pump Volumes				X	X
Cl_2 Contact Times		X			
Sample Volume	X	X	X		
Sample Time	X	X	X	X	X
Sample Location	X	X	X	X	X
Sample Weight				X	X
Preservation	X	X	X	X	X
Sample Loss	X	X	X	X	X
Process Irregularity	X	X	X	X	X
Sampler Configuration	X	X	X		
QA/QC Samples	X	X	X	X	X
Samples Submitted	X	X	X	X	X

2.3.6 Field QA/QC Program

The field QA/QC program involved the collection of field blanks. A field blank was an organic free distilled water sample that underwent the same handling in the field and the laboratory as the samples. The purpose of the field blank collection and subsequent analysis was to establish if contamination was being introduced into the samples from the sampling equipment or preservation methods, transportation and/or laboratory handling. In order to determine the sources of contamination, if any, it was necessary to compare field blank results with the laboratory method blank results.

A "grab" sample field blank was prepared by rinsing organic free water in the grab sampling container prior to sampling. The rinse water was placed in the sample bottle and preserved using methods appropriate for the compounds to be analyzed (see Table 2-8).

An automatic sampler field blank was prepared from organic free water which was pumped through the sampler tubing prior to sampling. As above, the water was bottled and preserved according to prescribed methods (Table 2-8).

During the entire program, a total of 19 field blank samples were collected.

In addition to the field QA/QC program, a number of laboratory QA/QC measures were taken; some requiring duplicate sample collection in the field. The laboratory QA/QC procedures are described in Section 3.0.

3.0 ANALYTICAL METHODOLOGY

3.1 Laboratory Analyses

Three laboratories were contracted by MOE to carry out the organics analyses on the samples from the 37 WPCPs. Zenon Environmental Incorporated in Burlington, Ontario did all of the analyses for the volatile organic compounds, dioxin/furan compounds and total phenols. The base neutral and acid extractable compounds were analyzed by Mann Testing Laboratories Ltd., in Mississauga, Ontario and the pesticides and herbicides analyses were carried out in the laboratories of Enviroclean Ltd., in London, Ontario.

In addition, the MOE Laboratory Services Branch (LSB) in Rexdale carried out the analyses for metals, conventional contaminants and cyanide. Table 3-1 presents a complete list of parameters analyzed by each analytical laboratory.

Table 3-2 presents the methods used by the laboratories for analysis of organic compounds and metals. A detailed description of these methods can be found in the individual laboratory reports, summarized by Zenon (Ref. 4). Table 3-3 presents the methods used to analyze the conventional contaminants.

3.2 Laboratory QA/QC Procedures For Trace Organic Compounds

A number of different techniques were regularly used in the laboratory for quality assurance of the analytical results. In addition to these methods, MOE Laboratory Services conducted an external quality assurance program. The quality assurance/quality control methods are presented in the following discussion.

Method Blanks

A method blank was analyzed routinely along with each batch of samples to identify possible contamination contributed by glassware, reagents, other samples, etc. A method blank consisted of an uncontaminated distilled water sample that underwent identical preparation methods (eg. extraction, purge and trap) and was analyzed with the field samples. A method blank was analyzed each time the instrumentation was set up for a new batch of samples.

The method blank analyses were used for two main purposes. Each day of analyses, method blank concentrations of each contaminant were averaged for all of the blanks analyzed that day. The average value was used to correct the concentrations of the particular contaminant in the samples on

Table 3-1
LIST OF CONTAMINANTS ANALYZED BY ANALYTICAL LABORATORIES

MOE Laboratory Services Branch

Metals and Cyanide

(Unfiltered, Total)

Aluminum
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Mercury
Molybdenum
Nickel
Selenium
Silver
Strontium
Zinc
Cyanide

Conventional Contaminants

Alkalinity
Ammonia Nitrogen
Biochemical Oxygen Demand
Chemical Oxygen Demand
Nitrate Nitrogen
Nitrite Nitrogen
Total Kjedhal Nitrogen
Total Phenols
Total Phosphorus
Total Solids
Total Suspended Solids
Turbidity
Volatile Solids
Volatile Suspended Solids

Zenon Environmental Incorporated

Volatile Organic Compounds

1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1-Octene
2-Chloroethylvinyl ether
3-Chloro-1-propene
3-Chloro-toluene
Acrolein
Acrylontrile
Benzene
Bromodichlorobenzene
Bromodichloromethane
Bromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloroethane
cis-1,3-Dichloropropene
cis-1,2-Dichloroethane
Dibromochloromethane
Dichlorodifluoromethane
Diethyl ether
Ethylbenzene
Hexane
Hexanol
Methylene chloride
Styrene
Tetrachloroethene
Toluene
trans-1,3-Dichloropropene
Trichloroethene
Trichlorofluoromethane
Vinyl bromide
Vinyl chloride

Dioxin/Furans

Tetrachlorodibenzodioxins
Tetrachlorodibenzofurans
Pentachlorodibenzodioxins
Pentachlorodibenzofurans
Hexachlorodibenzodioxins
Hexachlorodibenzofurans
Heptachlorodibenzodioxins
Heptachlorodibenzofurans
Octachlorodibenzodioxin
Octachlorodibenzofurans

Total Phenolics

Mann Testing Laboratories Ltd.

Base Neutral and Acid Extractable Compounds

2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethyl Phenol
2,4-Dinitrotoluene
2,4-Dinitro-o-cresol
2,6-Dinitrotoluene
2 Hydroxy-toluene (O-Cresol)
2-Chloronaphthalene
2-Chlorophenol
2-Nitrophenol
3 Hydroxy-toluene (M-Cresol)
4 Hydroxy-toluene (P-Cresol)
4-Bromophenyl phenyl ether
4-Chlorophenyl phenyl ether
9H Fluorene
Acenaphthene
Acenaphthylene
Alpha-naphthylamine
Ametryn
Anthracene
Atrazine
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Beta-naphthylamine
Biphenyl
bis(2-Chloro ethoxy)methane
bis(2-Chloro ethyl)ether
bis(2-Chloroispropyl)ether
bis(2-ethyl hexyl)phthalate
Butyl benzyl phthalate
Chrysene
Diazinon
Dibenzo(ah)anthracene
Dichloran
Diethyl phthalate
Dimethyl phthalate
Diphenyl ether
Di-n-butyl phthalate
Di-n-octyl phthalate
Fluoranthene
Indeno(123-CD)pyrene
Malathion
Naphthalene
Nitrobenzene
N-Nitroso diphenylamine
N-Nitroso-di-n-propyl-amine
Parathion ethyl
Parathion methyl
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
P-chloro-M-cresol
Tri-n-tolyl phosphate

Enviroclean Ltd.

Pestcidies and Herbicides

1,2,4-Trichlorobenzene
2,4,5-Trichlorophenoxyacetic acid
2,4-Dichlorophenoxyacetic acid
Aldrin
Alpha-BHC
Alpha-chlordane
Alpha-endosulphan
Beta-BHC
Beta-endosulphan
Captan
Delta-BHC
Dieldrin
Endosulphan sulphate
Endrin
Endrin aldehyde
Gamma-BHC
Gamma-chlordane
HCB
Heptachlor
Heptachlor epoxide
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Methoxychlor
Mirex
Oxychlordane
PCNB
Photomirex
PP-DDD
PP-DDE
PP-DDT
Silvex
Strobane
Total PCB
Toxaphene

Table 3-2
SUMMARY OF ANALYTICAL METHODS FOR TRACE ORGANICS AND METALS USED IN THE STUDY

Contaminant or Contaminant Group	Sample Prepration Method	Analytical Method	Instrumentation	Analytical Laboratory
Volatile Organic Compounds	Purge and trap	Gas Chromatography Mass Spectrometry (GC/MS) Capillary Column	NUTECH 8522 with Finnigan 4510 GCMS with Incos Data System Enviroclean Series 810 and Hewlett Packard (HP) Mass Selective Detector (MSD)	Zenon Environmental Inc.
PCDD/PCDF	Liquid/liquid extraction and cleanup	GC/MS Capillary Column	Finnigan 4510 GC/MS with Incos Data System	Zenon Environmental Inc.
Total Phenols	Dilution (if necessary) and distillation from acidified sample	Direct photometric method		Zenon Environmental Inc.
Acid Extractable Compounds	Liquid/liquid extraction and cleanup	GC/MS Capillary column	HP5970 B Mass Selective Detector HP5890 Gas Chromatograph HP9816 Computer System	Mann Testing Laboratories Ltd.
Base/Neutral Extractable Compounds	Liquid/liquid extraction	GC/MS Capillary column	HP5970 B Mass Selective detector HP5890 Gas Chromatograph HP9816 Computer System	Mann Testing Laboratories Ltd.
PCBs and Organochlorine Insecticides	Liquid/liquid extraction and cleanup	GC/MS Dual Capillary Column	Varian 6000 GC	Enviroclean Ltd.
Phenoxy Acid Herbicides	Liquid/liquid extraction and cleanup	GC/MS Dual Capillary Column	Hewlett Packard 5890	Enviroclean Ltd.
Metals (Ag, As, Cd, Cr, Co, Cu, Hg, Mo, Ni, Pb, Se, Zn, Al, Fe, Be, Ca, Mg)		Inductively Coupled Plasma Spectrometry (ICP) Direct Coupled Plasma Spectrometry (DCP)		MOE LSB

Table 3-3
SUMMARY OF ANALYTICAL METHODS FOR CONVENTIONAL CONTAMINANTS USED IN THE STUDY

Contaminant	Method	Reference*
pH	pH Electrode	Code 001 AI1 page 249
Chemical Oxygen Demand (COD)	Colourimetric measurement of trivalent chromium	Code 525 1C2 page 237
Biochemical Oxygen Demand (BOD)	Five day incubation	Code 001 A12 page 234
Dissolved Organic Carbon (DOC)	Filtration glass fibre filter ≦ 2 μm, combustion at <1000°C, colourometric detection	Code 102 AC@ page 89
Ammonia plus Ammonium (NH_3)	Distillation, colourimetry	Code 103 DC2 page 191
Nitrate (NO_3)	Colourimetry	Code 102 DC2 page 210
Nitrite (NO_2)	Colourimetry	Code 102 DC2 page 222
Total Kjeldhal Nitrogen (TKN)	Digestion, distillation and colourimetry	Code 004 AC2 page 228
Total Solids (TS)	Drying at 103 °C ± 3°C and gravimetry	Code 202 A16 page 342
Total Suspended Solids (TSS)	Filtration glass fibre filter ≦ 2 μm, drying at 103 °C ± 3°C and gravimetry	Code 506 AD4 Page 348
Volatile Suspended Solids (VSS)	As above, ignite filter for 4 hours at 550°C	Code 506 AD4 page 348
Total Phosphorus (TP)	Digestion, colourimetry	Code 504 AC2 page 279

* "1986 Performance Report", Water Quality Section, Ministry of the Environment

that day. Secondly, the method blank results for all of the analyses were used to determine if the background "noise" level was too high to use the data for a particular contaminant with confidence.

Duplicates

Duplicate samples were defined as two aliquots taken from a single sample and carried through the same analytical process. The purpose of duplicate analyses was to provide a measure of analytical precision. This was carried out by comparing the differences of each set of duplicates, and determining if the differences were statistically significant.

Native Spikes in Distilled Water Samples

A known amount of standard mixture containing selected native compounds on the monitoring list (Table 2-2) was spiked into a reagent water sample, which subsequently underwent the same preparation and analysis as the field samples.

With each batch of samples analyzed, a blank was spiked with each of the compounds to be analyzed in the sample, and the percentage recovery was documented. The following 2 results were then used to evaluate the applicability of the data for each batch of samples:

- The recovery of the native compound from the distilled water blank analyzed for each batch of samples.
- The recovery of the spiked compound from all of the distilled water blanks for the entire study.

Surrogate Spikes in Field Samples

A known amount of mixture containing deuterated target compounds was spiked into the field sample, which was subsequently processed and analyzed. The amount of recovery of the deuterated spike was used to indicate the recovery of the target compound from the sample and the variability of compound recovery.

MOE Laboratory Spiking

Duplicate field samples were sent to the MOE LSB. Some liquid samples and all sludge samples were labelled at the MOE LSB, to indicate they were replicate samples, and were then taken to the contract laboratory for analyses. Other

samples were spiked at the MOE LSB with known concentrations of target compounds of volatiles, organics and pesticides. The spiked samples were relabelled for identification as a spiked replicate of the field sample and then submitted for analyses to the appropriate laboratory. The results of the spiked samples were compared to the replicate unspiked sample. The purpose of the MOE laboratory spiking was to ensure the integrity of the results if the concentrations of native compounds in spiked samples were greater than in non-spiked samples, and to establish parameter stability in transport, storage and analysis.

3.3 Data Management and Review

Analytical and QA/QC results from each of the contract laboratories and from MOE LSB were input into MOE Laboratory Information System (LIS). The results were reviewed and approved by the pertinent MOE laboratory supervisors. The approved results were then transferred from the mainframe LIS to a microcomputer database at MOE using dBase III Plus software (Ashton-Tate) for ease in data analysis and reporting.

The finalized database was sent to CANVIRO for formatting, analysis, interpretation and summarizing.

4.0 WPCP CHARACTERISTICS

4.1 Background

Ideally, to effectively characterize wastewater treatment plant influents, effluents, sludges, removal abilities and drainage basin loadings in terms of HCs for Ontario WPCPs, all plants in Ontario would undergo the monitoring program. Since economic and time constraints would not allow for this, it was necessary to select a smaller group of plants that would be representative of all of the Ontario plants.

4.1.1 Ontario WPCPs

In 1987 in Ontario, there were 412 municipal treatment facilities, treating wastewater at a rate of 5.0 million cubic metres per day for a population of over 7 million people.

The 412 treatment facilities had a total hydraulic design capacity of over 6.0 million cubic metres per day. Figure 4-1 shows that in 1987, 82 percent of the facilities in Ontario had design capacities of less than 10,000 m^3/day and 36 percent of the 412 facilities were less than 1,000 m^3/day. Only 6.8 percent of the plants (27 plants) had capacities greater than 45,000 m^3/day but they contributed greater than 70 percent of the total flow in 1987.

Figure 4-2 shows that in 1987, 52 percent of the facilities in Ontario provided secondary treatment, 7.5 percent provided primary treatment, 39 percent were lagoons and 1.7 percent were facilities with no discharge to surface waters (ie. septic tanks, exfiltration plants). Secondary facilities in Ontario generated the largest portion (76.8 percent) of flow in 1987; 70 percent of which was contributed by conventional activated sludge plants. Lagoons and septic tanks typically serve smaller communities. Consequently, total flow contribution from these types of facilities was less than 2 percent.

The 412 facilities in Ontario are located throughout the Province. Larger facilities are primarily located in the Lake Ontario drainage basin, accounting for 58.4 percent of the total flow (based on 1987 flow) from Ontario plants. Lake Erie and Lake Huron received 17.2 and 7.3 percent respectively. The Ottawa River and St. Lawrence River drainage basins received a total of 13.6 percent and flow into Lake Superior, James Bay and Lake Winnipeg was 3.5 percent.

4.1.2 37 WPCPs in the Study

The total flows in 1987 at the 37 WPCPs was 3.7 million cubic metres per day, or 73.6 of the total Ontario flow for that year. Of the study plants, secondary treatment facil-

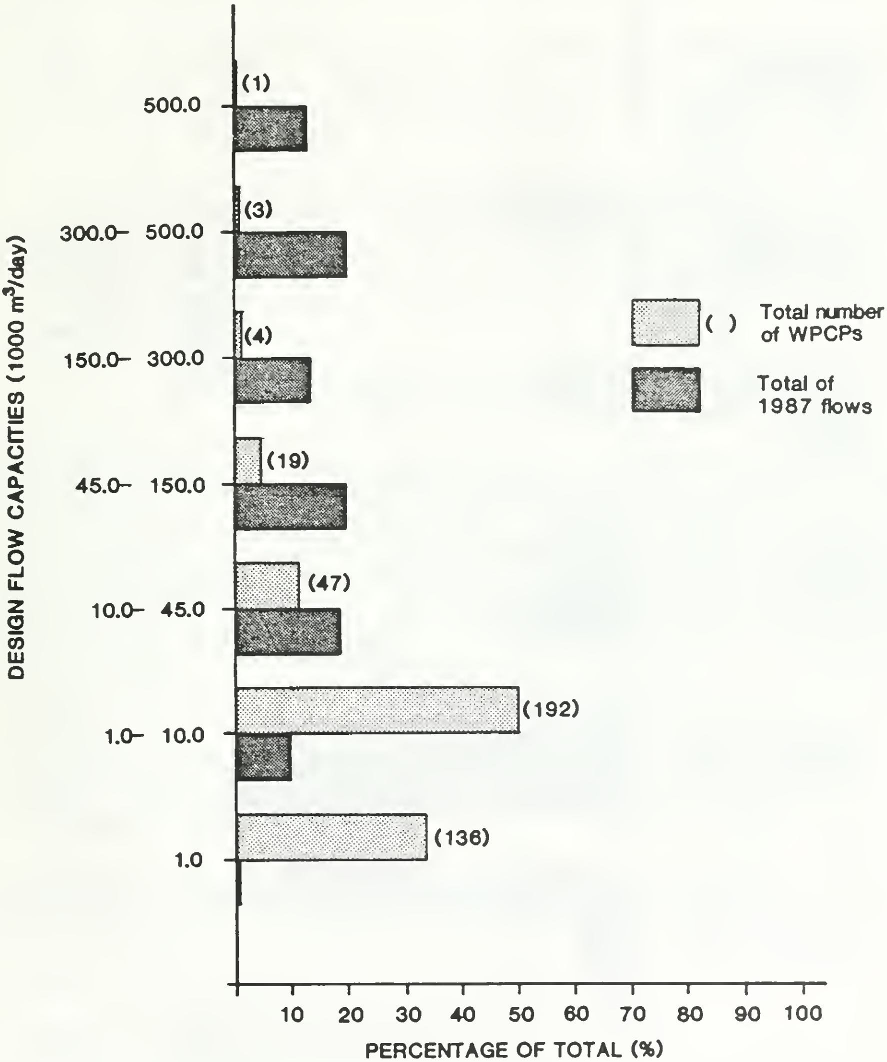

Figure 4-1
HISTOGRAM SHOWING DESIGN FLOW CAPACITIES FOR ONTARIO WPCPs (1987)

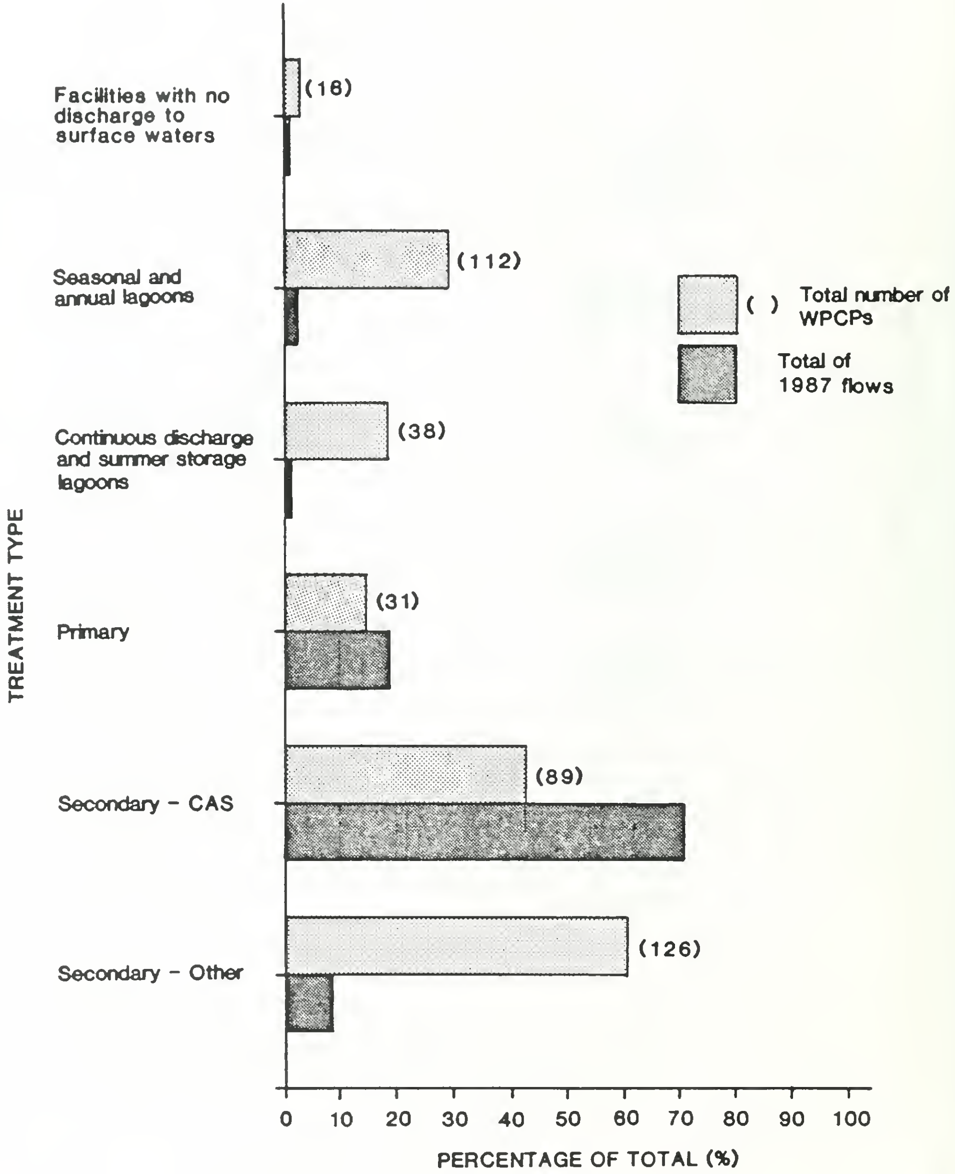

Figure 4-2
HISTOGRAM SHOWING TREATMENT TYPES FOR ONTARIO WPCPs (1987)

ities contributed to 77.9 percent of flows, primary facilities contributed to 21.6 percent and lagoons to 0.5 percent of these flows.

There were 28 secondary treatment plants involved in the study, comprising 76 percent of the 37 plants. Of these, 23 were conventional activated sludge plants (1 with tertiary treatment), 3 were extended aeration, one was high rate and one used rotating biological contactors.

The largest portion of flows from the selected WPCPs were to the Lake Ontario drainage basin, comprising 64.5 percent. Flows to the Lake Erie drainage basin comprised 16.5 percent, to Lake Huron comprised 2.4 percent and to Lake Superior, 2.2 percent. The Ottawa River and St. Lawrence drainage basins received 14.4 percent of the total flow from the 37 WPCPs.

4.1.3 Comparison Between Ontario WPCPs and 37 WPCPs Selected For Study

The histograms in Figure 4-3 present a comparison of the 37 plants selected for the study to Ontario WPCPs. As noted previously, the study WPCPs represented more than 70 percent of flows from all plants in Ontario in 1987 (Figure 4-3a). The quantities of flows from each type of treatment process (ie. secondary, primary and lagoons) for the study WPCPs are of similar proportions to those for all Ontario WPCPs (Figure 4-3b). In addition, the division of the total Ontario flows to each drainage basin is also represented fairly accurately by the study WPCPs (Figure 4-3d).

Figure 4-3c shows that a larger percentage of secondary treatment facilities were represented in the study than those existing in Ontario. Since one objective of the present study was to estimate the concentrations and/or removals of HCs in secondary WPCPs, a larger proportion of secondary plants was selected.

In summary, it can be observed that the study group of treatment facilities are a representative portion of all Ontario plants.

4.2 Characteristics of 37 WPCPS in Study

4.2.1 Summary of Communities

Table 4-1 presents a summary of the characteristics of the communities served by each of the study WPCPs.

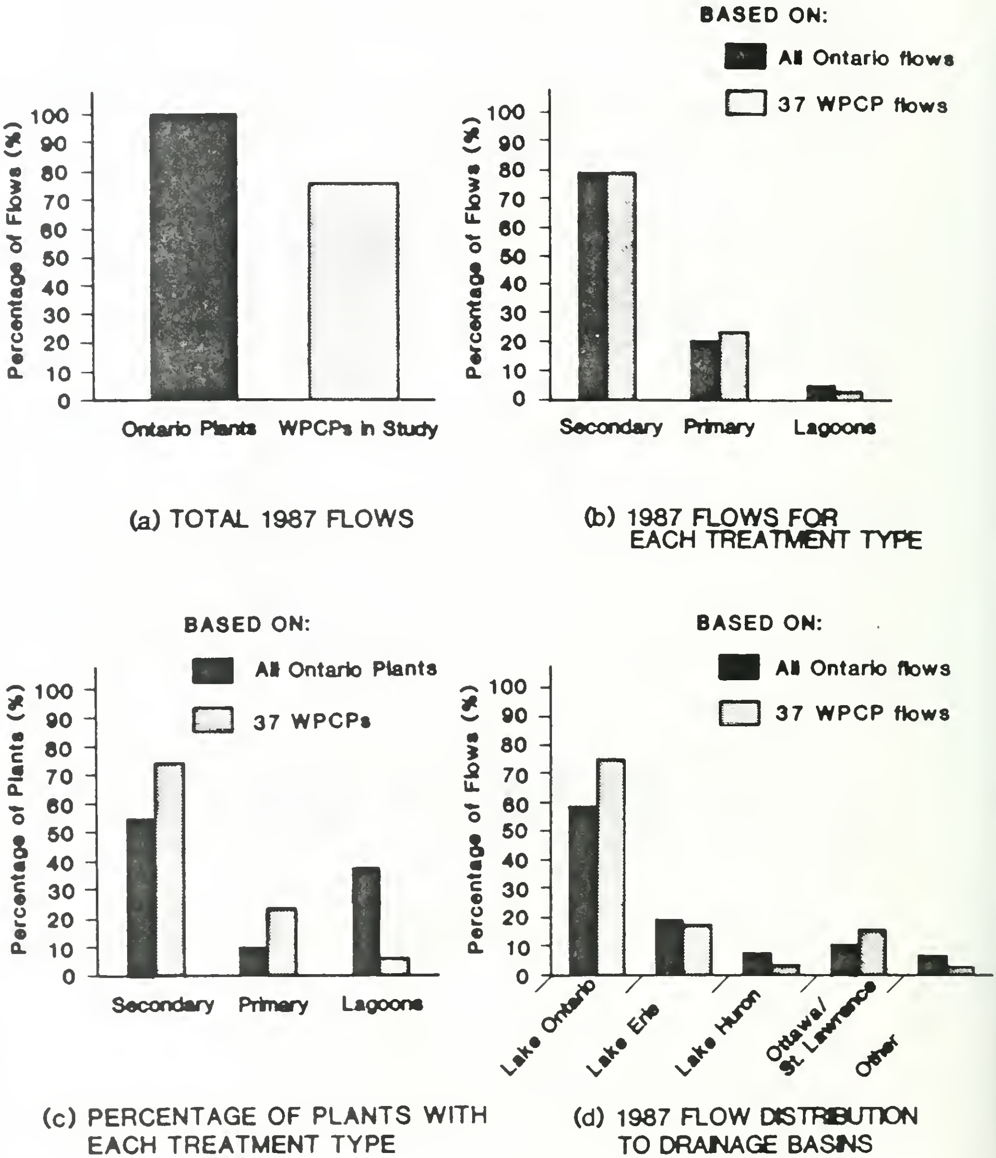

Figure 4-3

HISTOGRAM COMPARING ONTARIO WPCPs TO WPCPs SELECTED FOR THE STUDY

Table 4-1
SUMMARY OF COMMUNITIES OF 37 WPCPs

Plant	Population Served	Receiving Watercourse	Drainage Basin	% Industrial Flow
Guelph	82,000	Grand River	Lake Erie	25%
Belle River (Maidstone)	7,581	Lake St. Clair	Lake Erie	8%
Brantford	73,000	Grand River	Lake Erie	40%
Burlington (Skyway)	120,000	Hamilton Harbour	Lake Ontario	17%
Grimsby (Baker Rd.)	19,850	Lake Ontario	Lake Ontario	0%
Hamilton (Woodward)	300,000	Redhill Creek	Lake Ontario	10%
Kingston TWP	18,700	Lake Ontario	Lake Ontario	4%
Kitchener	138,271	Grand River	Lake Erie	39%
London (Greenway)	164,614	Thames River	Lake Erie	8%
London (Pottersburg)	25,979	Thames River	Lake Erie	9%
Mississauga (Clarkson)	120,000	Lake Ontario	Lake Ontario	25%
Mississauga (Lakeview)	370,000	Lake Ontario	Lake Ontario	12%
Moore (Corunna)	3,405	St. Clair River	Lake Erie	<1%
Oakville (S.E.)	21,900	Lake Ontario	Lake Ontario	<1%
Niagara Falls (Stamford)	67,835	Chippawa Power Canal	Lake Ontario	18%
Paris	4,359	Grand River	Lake Erie	32%
Peterborough	61,063	Otonabee River	Lake Ontario	22%
Pickering (Duffin Creek)	64,386	Lake Ontario	Lake Ontario	25%
Sault Ste. Marie (West)		St. Mary's River	Lake Huron	-
Sudbury	95,000	Junction Creek	Lake Huron	1%
Toronto (Highland Creek)	290,000	Lake Ontario	Lake Ontario	22%
Toronto (Humber)	660,000	Lake Ontario	Lake Ontario	19%
Toronto (Main)	1,200,000	Lake Ontario	Lake Ontario	8%
Toronto (North)	55,000	Don River	Lake Ontario	8%
Waterloo	66,627	Grand River	Lake Erie	13%
Wallaceburg	9,200	Sydenham River	Lake Erie	37%
Whitby (Pringle Ck #1)	10,925	Pringle Creek	Lake Ontario	22%
Windsor (Little River)	64,000	Little River	Lake Erie	24%
Cornwall	46,800	St. Lawrence River	St. Lawrence River	10%
Kingston (City)	67,000	St. Lawrence River	St. Lawrence River	2%
Ottawa (Green Creek)	450,000	Ottawa River	Ottawa River	3%
Sarnia	64,475	St. Clair River	Lake Erie	7%
Sault Ste. Marie (East)	75,000	St. Mary's River	Lake Huron	26%
Thunder Bay	101,529	Kaministikwia River	Lake Superior	9%
Windsor (Westerly)	123,000	Detroit River	Lake Erie	28%
Lindsay	14,636	Scugog River	Lake Ontario	19%
Niagara-on-the-Lake	5,210	Lake Ontario	Lake Ontario	25%

The population of the communities (based on 1987 MOE data) served by the WPCPs range from under 5,000 for Moore (Corunna) and Paris to cities of greater than 100,000 (Burlington, Hamilton, London, Mississauga, Toronto, Thunder Bay, and Windsor).

The receiving water courses for the plants depend on the geographic location of the communities being served. Typically, the receiving water course is a creek or river that is a tributary of one of the Great Lakes. Only 10 plants discharge directly into the major drainage basin of Lake Ontario (3 Toronto plants, 2 Mississauga plants, Pickering, Grimsby, Kingston, Niagara-on-the-Lake and Oakville), and one plant into the St. Lawrence River (Cornwall).

The industrial flow contributions to the study WPCPs range from less than 1 percent for Grimsby (Baker Road) WPCP, Oakville S.E. WPCP and Moore (Corunna) WPCP to about 40 percent for a number of WPCPs. The industrial flow data was taken from a separate MOE study. Municipalities were requested to provide MOE with annual water use data for the industries that discharged to the 37 WPCPs. Industrial flow into each WPCP was then estimated as 85 percent of the total annual water use for 250 days per year. Since annual water use data were not available for many industries, the industrial flow data percentages in Table 4-1 should be considered very approximate (Ref. 4).

4.2.2 Summary of WPCP Design Characteristics

A summary of the WPCP design characteristics, including flows, process type and sludge treatment and disposal methods is presented in Table 4-2.

Ten of the study plants have design flow capacities of greater than 100,000 m^3/d, 12 have capacities in the range of 45,000-100,000 m^3/d, 9 are in the range of 10,000-45,000 m^3/d, and 6 have design capacities of less than 10,000 m^3/d.

The percentage utilization of the plant design capacity (based on 1987 average daily flows) ranged from 36% for the new Sault Ste. Marie (West) plant to plants operating at or beyond their hydraulic design capacities (Waterloo, Wallaceburg, Cornwall, Toronto (Humber) and Niagara-on-the-Lake).

All of the secondary plants with the exception of Hamilton (Woodward) and Sudbury practice continuous chemical addition for phosphorus removal. Woodward WPCP used the industrially contributed iron in the raw wastewater for phosphorus removal. Sudbury was not practicing phosphorus removal at the time of the study. However, phosphorus removal equipment is presently being installed. All of the primary plants, with the exception of the Sault Ste. Marie (East) plant, also had continuous addition of chemicals for phosphorus removal. Only Lindsay lagoon uses chemicals for phosphorus removal. The Niagara-on-the-Lake lagoon has no phosphorus removal facilities.

Table 4-2

SUMMARY OF WPCP DESIGN AND FLOW DATA

Plant	Design Flow Capacity ($10^3 m^3$/day)	1987 Average Flow ($10^3 m^3$/day)	1987 Flow as % of Design	Process	Phosphorus Removal	Sludge Treatment	Sludge Disposal
Tertiary Plants							
Guelph	54.55	43.42	79.6	Conventional activated sludge plus RBC's plus filtration	Continuous	Co-thickening/anaerobic digestion/filter dewatering	Drying beds or landfill
Secondary Plants							
Belle River (Maidstone)	6.82	5.60	82.1	Extended aeration	Continuous	Aerobic Digestion	Hauled
Brantford	81.83	52.10	63.7	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Agricultural land or lagoon
Burlington (Skyway)	93.19	67.03	71.9	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Incineration and/or agricultural land
Grimsby (Baker Road)	18.18	13.05	71.8	Conventional activated sludge	Continuous	Anaerobic digestion	Agricultural land
Hamilton (Woodward)	409.14	306.47	74.9	Conventional activated sludge	Without Chemicals	Co-thickening/anaerobic digestion/filter dewatering	Incineration
Kingston TWP	25.00	18.03	72.1	Conventional activated sludge	Continuous	Anaerobic digestion	Drying bed on lagoon
Kitchener	122.70	70.58	57.5	Conventional activated sludge	Continuous	Anaerobic digestion/	Agricultural land
London (Greenway)	122.70	110.8	90.3	Conventional activated sludge	Continuous	Dissolved air flotation/ belt press dewatering	Incineration
London (Pottersburg)	22.05	16.33	74.1	Conventional activated sludge	Continuous	Co-thickening/storage	Incineration
Mississauga (Clarkson)	109.10	74.7	68.5	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Incineration or Agricultural land
Mississauga (Lakeview)	284.13	256.9	90.4	Conventional activated sludge	Continuous	Centrifuge thickening/ theraml conditioning/ vacuum filtration/ anaerobic digestion	Incineration and ash lagoon
Moore (Corunna)	4.46	2.18	47.9	Extended aeration	Continuous	Holding tank, decanted	
Niagara Falls (Stamford)	58.20	-	-	Rotating biological contactors	Continuous	Anaerobic digestion	Lagoon

(KIR18/284W)

Table 4-2
Continued

Plant	Design Flow Capacity ($10^3 m^3$/day)	1987 Average Flow ($10^3 m^3$/day)	1987 Flow as % of Design	Process	Phosphorus Removal	Sludge Treatment	Sludge Disposal
Oakville (S.E.)	22.73	13.52	59.5	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Agricultural land
Paris	7.05	2.52	35.7	Extended aeration	Continuous	Aerobic digestion/ thickening/storage	Agricultural land
Peterborough	68.19	50.79	74.5	Conventional activated sludge	Continuous	Co-thickening anaerobic digestion	Agricultural land
Pickering (Duffin Creek)	189.25	176.0	93.0	Conventional activated sludgde	Continuous	Co-thickening anaerobic digestion/filter dewatering	Incineration
Sault Ste. Marie (West)	18.18	6.65	36.6	Conventional activated sludge	Continuous	Co-thickening/filter dewatering	Landfill
Sudbury	68.19	48.97	71.8	High rate	No removal	Anaerobic digestion	Hauled
Toronto (Highland Creek)	218.21	170.0	77.9	Conventional activated sludge	Continuous	Dissolved air flotation/ anaerobic digestion/ grinding/heat treatment/ centrifuge dewatering	Incineration
Toronto (Humber)	409.19	402.7	98.4	Conventional activated sludge	Continuous	Dissolved air flotation/ anaerobic digestion/ elutriation/vacuum filtration	Landfill
Toronto (Main)	818.3	767.2	93.8	Conventional activated sludge	Continuous	Dissolved air flotation/ anaerobic digestion/thermal oxidation/filter dewatering	Incineration
Toronto (North)	45.46	36.65	80.6	Conventional activated sludge	Continuous	Anaerobic digestion/ centrifuge dewatering	Landfill
Waterloo	45.46	46.38	102.0	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Agricultural land
Wallaceburg	6.82	6.76	99.1	Conventional activated sludge	Continuous	Anaerobic digestion/filter dewatering	
Whitby (Pringle Cr. #1)	5.68	3.61	63.6	Conventional activated sludge	Continuous	Co-thickening/anaerobic digestion	Hauled to Whitby (Corbett Ck.) WPCP
Windsor (Little River)	36.32	32.76	90.2	Conventional activated sludge	Continuous	Co-thickening/centrifuge dewatering	Landfill

Table 4-2
Continued

Plant	Design Flow Capacity (10^3m^3/day)	1987 Average Flow (10^3m^3/day)	1987 Flow as % of Design	Process	Phosphorus Removal	Sludge Treatment	Sludge Disposal
Primary Plants							
Cornwall	37.50	43.68	116.5	Primary	Continuous	Anaerobic digestion/ centrifuge dewatering	Landfill
Kingston (City)	61.37	63.48	103.4	Primary	Continuous	Anaerobic digestion (centrifuge dewatering)/ storage	Agricultural land
Ottawa (Green Creek)	545.0	400.25	73.4	Primary	Continuous	Anaerobic digestion	Lagoon
Sarnia	70.47	54.00	76.6	Primary	Continuous	Anaerobic digestion	Lagoon
Sault Ste. Marie (East)	54.55	32.02	58.7	Primary	No removal	Vacuum filtration	
Thunder Bay	109.11	81.11	74.3	Primary	Continuous	Anaerobic digestion	Landfill
Windsor (Westerly)	163.65	123.64	75.6	Primary with polymer addition	Continuous	Centrifuge dewatering/ composting	Agricultural land
Lagoons							
Lindsay	17.18	14.18	82.5	Aerated cells plus lagoon	No removal	No sludge production	-
Niagara-on-the-Lake	3.80	6.40	168.4	Conventional lagoon	No removal	No sludge production	-

(KIR18/284W)

A wide range of sludge treatment methods were used at the 37 WPCPs to reduce the sludge volume before ultimate disposal. Processes for pre-thickening (not including co-thickening in the primary clarifiers) are used at 5 facilities. Anaerobic digestion of sludges is used at the majority (26) of the facilities. Two of the plants (Belle River, Clarkson) use aerobic digestion and 7 plants do not have sludge digestion processes before disposal, but do utilize dewatering processes. Additional treatment of digested sludges included dewatering (13 plants), elutriation (Humber WPCP) and heat treatment (Highland Creek WPCP, Main WPCP and Lakeview WPCP).

Three main methods of sludge disposal are utilized, including incineration application to agricultural land and landfilling. In some cases, sludge is transferred to another WPCP for treatment and/or disposal.

4.2.3 Historical WPCP Performance Summary

Table 4-3 presents the annual average effluent concentrations of BOD_5, suspended solids (TSS) and phosphorus for the 37 plants of this study, for 1986 and 1987. Also indicated is whether the plant complied with the MOE minimum effluent requirements for municipal treatment facilities presented in Table 4-4. It should be noted that plant specific effluent requirements, as required by some WPCPs, were not considered in the evaluation of compliance.

Table 4-3 shows that the secondary plants selected have generally complied in the past with the BOD_5 and TSS requirements. Out of the 7 primary plants, Cornwall WPCP did not comply with TSS requirements in both years, and Ottawa (Green Ck) WPCP did not comply with BOD_5 removal requirements in both years. Both Lindsay and Niagara-on-the-Lake lagoons were in compliance with respect to BOD_5 in both years. However, Lindsay did not comply with TSS limits in 1987.

In 1986 and 1987, only 24 of the study plants were in compliance with the phosphorus requirement of ≤ 1.0 mg/L, assessed on a monthly average basis. Seven plants were out of compliance in one year, and 3 plants (Peterborough, Cornwall and Green Creek) did not comply in either year. Three plants (Sudbury, Sault Ste. Marie East, and Niagara-on-the-Lake) did not have phosphorus removal in 1986 and 1987 and therefore were not subjected to a phosphorus requirement.

Table 4-3
SUMMARY OF HISTORICAL PERFORMANCE OF 37 WPCPs (1981-1986)

Plant	Annual Average Effluent BOD_5 (mg/L)				Annual Average Effluent TSS (mg/L)				Annual Average Effluent TP (mg/L)				Comments
			Compliance				Compliance				Compliance*		
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	
Tertiary													
Guelph	10.7	14.1			8.9	12.8			1.0	0.6	N		
Secondary													
Belle River (Maidstone)	16.7	4.9			14.8	11.1			0.8	0.7			
Brantford	12.2	13.4			10.4	11.2			0.8	1.0		N	
Burlington (Skyway)	10.8	9.3			9.5	7.3			0.7	0.7			
Grimsby (Baker Road)	13.8	20.6			9.4	11.0			0.5	0.5			
Hamilton	15.7	27.5	N		19.1	12.3			0.7	1.0		N	Phosphorus removal without chemicals
Kingston TWP	8.3	7.5			9.5	8.1			1.0	0.8	N		
Kitchener	12.1	15.5			5.2	5.2			0.7	0.8			
London (Greenway)	4.0	4.8			10.1	12.3			0.7	0.7			
London (Pottersburg)	2.6	3.3			4.3	5.3			0.6	0.6			
Mississauga (Clarkson)	12.7	14.2			9.2	10.0			0.8	0.9			
Mississauga (Lakeview)	16.4	17.8			14.0	14.3			0.6	0.7			
Moore (Corunna)	7.0	7.0			9.8	7.5			0.6	0.4			
Niagara Falls (Stamford)	20.9	11.9			16.5	15.8			0.6	0.7			Primary plant before 1987
Oakville (S.E.)	5.0	2.9			8.4	6.5			0.6	0.5			
Paris	8.7	5.0			6.6	5.4			0.6	0.5			
Peterborough	14.3	9.9			5.5	6.2			3.6	1.0	N	N	
Pickering (Duffin Creek)	22.3	19.8			20.6	13.4			1.0	0.6	N		
Sault Ste. Marie (West)	12.2	11.5			9.9	8.6			1.0	0.9	N		
Sudbury	12.9	12.2			12.6	8.3			2.2	2.3	NR	NR	No phosphorus removal at present. 1988 installation.
Toronto (Highland Creek)	18.7	9.8			23.8	19.0			0.8	0.8			
Toronto (Humber)	11.3	9.0			21.1	20.1			1.0	0.9	N		

Notes: * Compliance is assessed on a monthly average. For compliance, all months TP average ≤ 1.0 mg/L.
NR = No effluent requirements for plants without phosphorus removal.

(KIR18/284W)

Table 4-3
Continued

Plant	Annual Average Effluent BOD_5 (mg/L)				Annual Average Effluent TSS (mg/L)				Annual Average Effluent TP (mg/L)				Comments
			Compliance				Compliance				Compliance*		
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	
Toronto (Main)	17.1	11.4			29.6	23.0	N		0.9	0.6			
Toronto (North)	17.9	18.1			6.6	9.3			0.7	0.8			
Waterloo	6.8	7.5			9.3	14.3			0.9	0.8			
Wallaceburg	16.9	11.1			14.2	9.6			0.5	0.7			
Whitby (Pringle Cr. #1)	10.2	6.3			10.4	12.3			0.6	0.6			
Windsor (Little River)	5.4	5.1			9.1	8.8			0.7	0.5			
Primary													
Cornwall	41.1	38.6	N	N	25.5	28.6			2.5	1.0	N	N	
Kingston (City)	23.7	18.1			16.5	16.5			0.6	0.6			
Ottawa (Green Cr.)	34.5	38.6			72.9	32.5	N	N	1.9	2.2	N	N	
Sarnia	33.1	39.1			20.2	24.1			0.7	0.9			
Sault Ste. Marie (East)	69.9	66.1			41.5	38.8			3.4	2.4	NR	NR	No phosphorous removal
Thunder Bay	53.2	57.7			51.4	70.7			0.9	1.0			
Windsor (Westerly)	25.9	24.2			20.6	23.3			0.7	0.7			
Lagoons													
Lindsay	10.5	10.5			81.1	11.0	N		2.6	0.7			
Niagara-on-the-Lake	27.7	23.5			26.9	28.0			3.1	3.3	NR	NR	No phosphorous removal

Notes: * Compliance is assessed on a monthly average. For compliance, all months TP average $\leq$1.0 mg/L.
NR = No effluent requirements for plants without phosphorus removal.

(KIP18/284W)

Table 4-4
MOE 1987 Effluent Discharge Requirements for
Ontario Wastewater Treatment Facilities

Treatment Type	Requirements	Basis
Secondary with phosphorus removal	BOD_5 ≤25 mg/L TSS ≤25 mg/L TP ≤1.0 mg/L	Annual Average Annual Average Monthly Average
Secondary without phosphorus removal	BOD_5 ≤25 mg/L TSS ≤25 mg/L	Annual Average Annual Average
Primary with phosphorus removal	BOD_5 Removal ≥50% TSS Removal ≥70% TP ≤1.0 mg/L	Annual Average Annual Average Monthly Average
Primary without phosphorus removal	BOD_5 Removal >30% TSS Removal >50%	Annual Average Annual Average
Lagoon with phosphorus removal	BOD_5 ≤30 mg/L TSS ≤40 mg/L TP ≤1.0 mg/L	Annual Average Annual Average Monthly Average
Lagoon without phosphorus removal	BOD_5 ≤30 mg/L TSS ≤40 mg/L	Annual Average Annual Average Monthly Average

5.0 RESULTS AND ANALYSIS

5.1 QA/QC Analytical Results

Detailed descriptions of the QA/QC program results from each contract laboratory are presented in individual laboratory reports, which in turn have been summarized in a report by Zenon Environmental Inc. (Ref. 4).

5.1.1 Detection Limits (DLs)

For the purposes of the present study, each target pollutant in each sample type was assigned a detection limit (DL). It was not intended that the DLs represent the lowest detection capability achievable, but rather, that they reflect a routinely available capability that would serve the needs of the study. In this regard, the statistical significance of a true method detection limit (MDL) (Ref. 5) cannot be used for the DLs. The resulting DLs for the present study for samples of raw wastewater, effluent water and sludges are presented in Tables 5-1(a) to 5-1(c).

For base neutral and acid extractable compounds (Table 5-1(a)) compound DLs were in the range of 10 to 75 µg/L for raw sewage, 2 to 15 µg/L for final effluents and 0.2 to 2 mg/L for sludges.

For volatile organic compounds, (Table 5-1(b)), compound DLs were in the range of 40 - 400 µg/L (with one exception of 5 mg/L for hexanol) for raw sewage, 2 to 100 µg/L (with the exception of 400 µg/L for hexanol) for final effluents, and from 40 to 400 µg/L (5 mg/L for hexanol) for sludges.

For pesticides and herbicides, compound DLs were in the range of 0.02 to 10 µg/L for raw sewage, 0.01 to 2 µg/L for final effluents and 0.2 to 100 µg/L for sludges.

For dioxin/furan analyses, due to the complexity of the samples, the DLs were highly variable depending on the cleanliness, homogeneity and interference associated with an individual sample. Therefore, a DL was established for each individual sample. The DLs for more than 95 percent of the samples ranged from 0.1 to 5 ng/L for raw sewage and final effluents, and from 0.05 to 4 µg/L for sludges. Table 5-1(d) presents the minimum DLs found for each of the compounds.

For metals analyses (Table 5-1(e)) DLs ranged from 0.01 to 0.05 mg/L for raw sewages and final effluents. The DL for mercury was the exception with a value of 0.01 µg/L. The range of metals DLs for sludges was 0.01 to 3 mg/L, with a DL for mercury of 0.01 µg/L. The method detection limit for cyanide was 1 µg/L for all three sample types.

Table 5-1(a)
DETECTION LIMITS BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS

Compound Name	Compound Code	DL Raw Sewage (µg/L)	DL Effluents (µg/L)	DL Sludges (liquid) (µg/L)
2,4,5-Trichlorophenol	X3245	25	5	500
2,4,6-Trichlorophenol	X3246	25	5	500
2,4-Dichlorophenol	PM24DP	25	5	500
2,4-Dimethyl phenol	PM24MP	25	5	500
2,4-Dinitrotoluene	PM26DT	15	3	300
2,6-Dinitrotoluene	PM24DT	15	3	300
2 Hydroxy-toluene (O-Cresol)	PMOCRE	15	3	300
2-Chloronaphthalene	PN2CNA	10	2	200
2-Chlorophenol	X30010	25	5	500
2-Nitrophenol	PM2NP	25	5	500
3 Hydroxy-toluene (M-Cresol)	PMMCRE	15	3	300
4 Hydroxy-toluene (P-Cresol)	PMPCRE	15	3	300
4-Bromophenyl phenyl ether	PM4BPE	15	3	300
4-Chlorophenyl phenyl ether	PM4CPE	10	2	200
9H Fluorene	PNFLUO	10	2	200
Acenaphthene	PNACNE	15	3	300
Acenaphthylene	PNACNY	15	3	300
Alpha-naphthylamine	PMANAA	50	10	1000
Ametryn	P2AMET	25	5	500
Anthracene	PNANTH	10	2	200
Atrazine	P2ATRA	25	2	500
Benzo(a)anthracene	PNBAA	10	2	200
Benzo(a)pyrene	PNBAP	10	2	200
Benzo(b)fluoranthene	PNBBFA	10	2	200
Benzo(k)fluoranthene	PNBKF	10	2	200
Beta-naphthylamine	PMBNAA	75	15	2000
Biphenyl	PNB1PH	15	3	300
bis(2-Chloro ethoxy)methane	PMB2EM	10	2	200
bis(2-Chloro ethyl)ether	PMB2NE	15	3	300
bis(2-Chloroispropyl)ether	PMB2IE	10	2	200
bis(2-ethyl hexyl)phthalate	PMBEHP	10	2	200
Butyl benzyl phthalate	PMBBP	10	2	200
Chrysene	PNCHRY	10	2	200
Diazinon	P4DIAZ	25	5	500
Dibenzo(ah)anthracene	PNDAHA	25	5	500
Dichloran	PODICH	50	10	1000
Diethyl phthalate	PMDEP	25	5	500
Dimethyl phthalate	PMDMP	10	5	200
Diphenyl ether	PMDPE	25	5	500
Di-n-butyl phthalate	PMDNBP	10	2	200
Di-n-octyl phthalate	PMDNOP	15	3	300
Fluoranthene	PNFLAN	10	2	200
Indeno(123-CD)pyrene	PNINP	25	5	500
Malathion	P4MALA	25	5	500
Naphthalene	PNNAPH	10	2	200
Nitrobenzene	PMNITB	10	2	200
N-Nitroso diphenylamine	PMNND	10	2	200
N-Nitroso-di-n-propyl-amine	PMNNP	2	10	200
Parathion ethyl	P4EPAR	25	5	500
Parathion methyl	P4MPAR	25	5	500
Pentachlorophenol	X3PCPH	25	5	500
Phenanthrene	PNPHEN	10	2	200
Phenol	PMPHEN	15	3	300
Pyrene	PNPYR	15	3	300
P-chloro-M-cresol	PMPCMC	25	5	500
Tri-n-tolyl phosphate	POTOC			

Table 5-1(b)
DETECTION LIMITS FOR VOLATILE ORGANIC COMPOUNDS

Compound Name	Compound Code	DL Raw Sewage (µg/L)	DL Effluents (µg/L)	DL Sludges (liquid) (µg/L)
1,1,1-Trichloroethane	X1111T	40	2	40
1,1,2,2-Tetrachloroethane	X11122	40	2	40
1,1,2-Trichloroethane	X1112T	40	5	40
1,1-Dichloroethene	X111CE	40	2	40
1,1-Dichloroethene	X1DCLE	40	2	40
1,2-Dichlorobenzene	X212CB	40	2	40
1,2-Dichloroethane	X112CE	40	2	40
1,2-Dichloropropane	X112CP	40	2	40
1,3-Dichlorobenzene	X213CB	40	2	40
1,4-Dichlorobenzene	X214CB	40	2	40
1-Octene	B1OCTE	60	3	60
2-Chloroethylvinyl ether	PM2CEE	40	10	40
3-Chloro-1-propene	X2CPPE	40	2	40
3-Chloro-toluene	X23CTD	40	2	40
Acrolein	X2ACRO	400	100	400
Acrylonitrile	X1ACRY	400	100	400
Benzene	B2BENZ	40	2	40
Bromodichlorobenzene	B2BDCL	40	10	40
Bromodichloromethane	X1BDCM	60	3	60
Bromoethane	X1BETH	40	2	40
Bromoform	XIBROM	60	10	60
Carbon tetrachloride	X1CTET	40	2	40
Chlorobenzene	X2CBEN	40	2	
Chloroethane	XICHLE	40	2	40
Chloroform	XICHLO	40	2	40
Chloromethane	X1CHLM	40	20	40
cis-1,3-Dichloropropene	X113DP	60	3	60
cis-1,2-Dichloroethylene	X1CDCE	40	2	
Dibromochloromethane	X1CDBM	40	2	
Dichlorodifluoromethane	XIDCFM	40	20	40
Diethyl ether	E1DIEE	40	2	40
Ethylbenzene	B2BENZ	40	2	40
Hexane	B1HEXA	60	3	60
Hexanol	L1HEX	5000	400	5000
Methylene chloride	X1DCLM	60	3	60
Styrene	B2STYR	40	3	40
Tetrachloroethylene	XITETR	40	2	
Toluene	B2TOLU	40	2	40
trans-1,3-dichloropropene	X113DR	40	2	40
Trichloroethylene	X1TRIC	40	2	
Trichlorofluoromethane	X1TCFM	40	2	40
Vinyl bromide	B1VBR	60	3	60
Vinyl chloride	X1VCL	100	50	100

Table 5-1(c)
DETECTION LIMITS FOR PESTICIDES AND HERBICIDES

Compound Name	Compound Code	DL Raw Sewage (µg/L)	DL Effluents (µg/L)	DL Sludges (liquid) (µg/L)
1,2,4-Trichlorobenzene	X2124	0.02	0.01	0.2
2,4,5-T	P3245T	0.1	0.05	1
2,4-D	P324D	0.04	0.02	0.4
Aldrin	P1ALDR	0.04	0.02	0.2
Alpha-BHC	P1BHCA	0.02	0.01	0.2
Alpha-chlordane	P1CHLA	0.02	0.01	0.2
Alpha-endosulphan	PIEND1	0.02	0.01	0.2
Beta-BHC	P1BHCB	0.02	0.01	0.2
Beta-endosulphan	P1END2	0.02	0.01	0.2
Captan	POCAPN	0.4	0.2	4
Delta-BHC	P1BCHD	0.02	0.01	0.2
Dieldrin	P1DIEL	0.02	0.01	0.2
Endosulphan sulphate	P1ENDS	0.08	0.04	0.8
Eldrin	P1ENDR	0.02	0.01	0.2
Eldrin aldehyde	P1ENDA	0.4	0.2	4.0
Gamma-BHC	P1BHCG	0.02	0.01	0.2
Gamma-chlordane	P1CHLG	0.02	0.01	0.2
Heptachlor	P1HEPT	0.02	0.01	0.2
Heptachlor epoxide	P1HEPE	0.02	0.01	0.2
Hexachlorobenzene	X2HCB	0.02	0.01	0.2
Hexachlorobutadiene	X1HCB	0.2	0.1	2
Hexachlorocyclopentadiene	X1HCCP	0.2	0.1	2
Hexachloroethane	X1DCLE	10	2	40
Methoxychlor	PIDMDT	0.01	0.05	1.1
Mirex	P1MIRX	0.02	0.01	0.2
Oxychlordane	P1DCHL	0.02	0.01	0.2
PCNB	POPCNB	0.1	0.05	1
Photomirex	P1PMIR	0.02	0.01	0.2
PP-DDD	P1PPDD	0.02	0.01	0.2
PP-DDE	P1PPDE	0.02	0.01	0.2
PP-DDT	P1PPDT	0.02	0.04	0.8
Silvex	P3SILV	0.1	0.05	1
Strobane	P1STRO	10	5	100
Total PCB	P1PCPT	0.08	0.04	0.8
Toxaphene	P1TOX	0.08	0.04	0.8

Table 5-1(d)
DETECTION LIMITS FOR DIOXIN/FURAN COMPOUNDS

Compound Name	Compound Code	DL Raw Sewage (ng/L)	DL Effluents (ng/L)	DL Sludges (liquid) (µg/L)
Tetrachlorodibenzodioxins	P94CDD	0.5	0.1	0.15
Tetrachlorodibenzofurans	P94CDF	0.2	0.1	1.50
Pentachlorodibenzodioxins	P95CDD	1.0	0.5	0.6
Pentachlorodibenzofurans	P95CDF	0.4	0.1	0.5
Hexachlorodibenzodioxins	P96CDD	1.0	0.3	0.4
Hexachlorodibenzofurans	P96CDF	0.7	0.1	1.0
Heptachlorodibenzodioxins	P97CDD	1.0	0.1	2.0
Heptachlorodibenzofurans	P97CDF	1.0	0.1	1.0
Octachlorodibenzodioxin	P98CDD	1.0	0.3	0.2
Octachlorodibenzofuran	P98CDF	1.0	0.2	0.5

Table 5-1(e)
DETECTION LIMITS FOR METALS AND CYANIDE

Compound Name	Compound Code	DL Raw Sewage (mg/L)	DL Effluents (mg/L)	DL Sludges (liquid) (mg/L)
Aluminum	ALUT	0.02	0.02	0.5
Beryllium	BEUT	0.01	0.01	0.5
Cadmium	CDUT	0.003	0.003	0.5
Calcium	CAUT	0.002	0.002	0.5
Chromium	CRUT	0.01	0.01	0.5
Cobalt	COUT	0.01	0.01	1
Copper	CUUT	0.01	0.01	0.5
Cyanide	CCNFUR	0.001	0.001	0.001
Lead	PBUT	0.03	0.03	0.5
Magnesium	MGUT	0.01	0.01	0.5
Mercury (µg/L)	HGUT	0.01	0.01	0.01
Molybdenum	MOUT	0.01	0.01	0.25
Nickel	NIUT	0.01	0.01	3
Selenium	SEUT	0.03	0.03	1
Silver	AGUT	0.01	0.01	0.5
Strontium	SRUT	0.01	0.01	0.5
Zinc	ZNUT	0.02	0.02	0.5

5.1.2 Method Blank Results

As previously noted in Section 3, one method blank with each batch of samples was routinely analyzed at each contract laboratory performing organics analyses. The results were used to establish the background contamination or "noise level" of each contaminant.

At the end of each day, the arithmetic mean of the compound concentration for each compound was calculated, and subtracted for the compound concentration measured in each sample for that day. This calculation was made to correct samples for the background "noise level".

When the analyses had been completed for all samples for a specific stream type, the arithmetic mean and standard deviation for the concentrations of each contaminant in the method blanks were calculated.

Since the "noise level" varied from day to day, MOE LSB staff felt that the "noise level" averaged over the duration of the study would be representative of the contamination problem with the compound in question, while the "noise level" established for each analytical run may not have been representative of that particular run. For this purpose, MOE established a criterion to determine if the "noise" level was too high to use the sample analytical data with confidence. If twice the standard deviation of the method blank results was greater than the analytical result for a compound averaged for a particular stream type, then the background concentration was considered too high, the entire analytical results for that compound were not considered valid and the compound was excluded from the data presentation for that stream types. Table 5-2(a) presents the compounds detected in 5 percent or more of the laboratory blank samples analyzed. Table 5-2(b) presents a list of the contaminants that did not meet the blank criterion, and are subsequently excluded from further result presentation.

5.1.3 Field Blank Results

There were a total of 19 field blank samples analyzed, including 8 for volatile organic compounds, 9 for base-neutral and acid extractable compounds and pesticide/ herbicide compounds and 2 for dioxin/furan compounds. The field blanks were analyzed for all of the target compounds in each group.

Table 5-3 presents the contaminants identified in field blanks.

Table 5-2(a)
CONTAMINANTS DETECTED IN METHOD BLANK SAMPLES

Compound	Average Concentration (µg/L)	Standard Deviation (µg/L)	No. of Samples Analyzed	No of Times Times Compound was Detected
Di-n-butyl phthalate	1.5	2.8	75	49
Bis-2-Ethylhexyl phthalate	47.7	84.8	75	70
Di-n-octyl phthalate	0.2	0.9	75	6
Di-ethyl phthalate	0.3	1.7	75	7
Methylene chloride	9	6	73	66
Chloroform	3	3	73	29
Toluene	3	5	73	43
Benzene	4	3	73	42
Hexane	7	11	73	40
Bromodichloromethane	3	1	73	9
Methoxychlor	0.08	0.03	34	3

Table 5-2(b)
CONTAMINANTS WITH INVALID ANALYTICAL RESULTS DUE TO METHOD BLANK RESULTS

Contaminant		Sample Types						
Code	Name	Raw Sewage	Primary Effluent	Lagoon Effluent	Secondary Effluent	Tertiary Effluent	Raw Sludge	Treated Sludge
X1CHLO	Chloroform		X		X	X		
B1HEXA	Hexane		X	X	X		X	X
B2BENZ	Benzene		X	X	X		X	X
X1BDCM	Bromodichloromethane		X		X			
B2TOLU	Toluene		X	X	X		X	X
PMPEHP	Bis-2-Ethylhexyl phthalate	X	X	X	X		X	X
PMDNBP	Di-n-butyl phthalate		X	X	X		X	X
PMDNOP	Di-n-octyl phthalate		X	X			X	
PMDEP	Diethyl phthalate			X	X		X	
X1DCLM	Dichloromethane		X	X	X		X	X
P1PMDT	Methoxychlor		X		X			

Notes: X - indicates that the data for the contaminant in the indicated sample type did not meet study QA/QC criteria and was therefore deleted from subsequent evaluation.

Table 5-3
CONTAMINANTS DETECTED IN FIELD BLANKS

Compound Group	Parameter	Concentrations	Frequency
Base-neutral and acid extractables	Di-n-butyl phthalate	3.2 µg/L	1/9 samples
Pesticides/ Herbicides	Methoxychlor	0.1 µg/L, 0.1 µg/L	2/9 samples
	Endosulphan Sulphate	0.09 µg/L	1/9 samples
	2,4-Dichlorophenoxy-acetic acid	0.04 µg/L	1/9 samples
Volatiles	Hexane	13.0 µg/L	1/8 samples

Only 5 organic compounds were detected in the field blanks at concentrations greater than the DLs and in a maximum of 22 percent of tested samples. No dioxin compounds were detected in field blanks.

It was concluded from the field blank results that the level of contamination introduced from the field equipment field sample handling methods and sample transport was not significant.

5.1.4 Results of Duplicate Analyses

Duplicate analyses were carried out in each analytical laboratories in order to determine the variability of the sample results. These results are presented in detail in the individual laboratory reports (Ref. 4).

In a large percentage of the duplicate analyses carried out, one or both of the aliquots results were below the DL and comparisons could not be made. Since there were so few usable duplicate results, the analytical variability as evaluated using these results was inconclusive.

5.1.5 Surrogate Spike Recoveries

Deuterated compounds were added as surrogate spikes to each sample analyzed for volatile and base/neutral acid extractable compounds. Bromofluorobenzene was also added in the spike mixture for volatiles analysis. For dioxin and furan analyses C^{12} labelled tetra and octa dioxin congenors were spiked into the samples. No surrogate spikes were added to samples for pesticide/herbicide analysis since mass spectrometry was not employed for the analysis of these compounds.

Table 5-4(a) - Table 5-4(c) summarize the recoveries of the surrogates by sample type. The summary results show that recoveries of the same surrogate compound in each sample type are very similar (no statistically significant difference at 95% confidence level). Consequently, it was concluded that there was no significant effects of the stream type during this study and the compound recoveries obtained in the blank water spike samples could be used as an indication of average recoveries for all sample types.

Table 5-4(a)
BASE/NEUTRAL COMPOUND SURROGATE RECOVERY SUMMARY BY STREAM TYPE

	Surrogate Compound				
	d_5-phenol	d_4-nitrophenol	d_8-naphthalene	d_{10}-anthracene	d_{12}-benzo-a-pyrene
Raw Sewage					
Average	38%	71%	72.7%	110.3	89.2
Std. dev.	5.4%	15.6%	14.8%	19.7%	14.3%
No. of data averaged*	280	280	280	280	280
Primary Effluent					
Average	38.6%	71.0%	70%	107%	90.5%
Std. dev.	6.3	13.5%	16.8%	15.5%	16.7%
No. of data averaged*	37	37	37	37	37
Secondary Effluent					
Average	37%	71%	67.9%	102.5%	90.5%
Std. dev.	5.2%	15.6%	12.4%	19.2%	15.9%
No. of data averaged*	280	280	280	280	280
Sludges					
Average	52%	70%	72.6%	112.7%	80.5%
Std. dev.	10.9%	18.2%	17.8%	29.2%	17.8%
No. of data averaged*	117	117	117	117	117
Method Blank					
Average	36%	68%	73%	89%	89%
Std. dev.	22%	29%	30%	30%	30%
No. of data averaged*	72	72	72	72	72

Notes: * - No surrogate data were rejected in any case

Table 5-4(b)
DIOXIN/FURAN COMPOUND SURROGATE RECOVERY BY SAMPLE TYPE

	13C12-T4CDD				13C12-08CDD			
Sample Type	Average % Rec.	Std. Dev. %	No. of data averaged	No. of Data rejected	Average % Rec.	Std. Dev. %	No. of data averaged	No. of data rejected
Primary Effluent	60.8	18.9	8	0	64.3	14.7	7	1
Secondary Effluent	51.8	22.4	49	3	66.9	28.3	52	0
Recycle	59.1	14.4	8	2	64.7	20.5	9	1
Raw Sewage	58.4	27.3	54	3	63.6	24.8	57	0
Sludge	78.3	36.8	74	12	72.3	27.9	85	1
Method Blank	56.4	28.4	24	0	65.6	24.3	23	1
Native Spike	36.7	18.5	12	0	48.6	22.2	12	0

Table 5-4(c)
VOLATILE ORGANIC COMPOUND SURROGATE RECOVERY BY SAMPLE TYPE

	d4-Dichloroethane				Bromofluorobenzene				d8-Toluene				d5-Chlorobenzene			
Sample Type	Avg.% Rec.	Std. Dev.%	No. Averaged	No. Rejected	Avg.% Rec.	Std. Dev.%	No. Averaged	No. Rejected	Avg.% Rec.	Std. Dev.%	No. Averaged	No. Rejected	Avg.% Rec.	Std. Dev.%	No. Averaged	No. Rejected
Primary Effluent	97	12	35	1	92	15	33	3	95	13	36	0	93	16	36	0
Secondary Effluent	96	16	225	8	97	16	205	28	94	12	222	11	96	16	225	8
Recycle 103	18	43	1	99	17	37	7	100	11	42	2	102	11	41	3	
Raw Sewage	100	14	212	5	99	16	194	23	100	10	213	4	99	14	208	9
Sludge	104	12	87	7	100	18	83	11	103	11	93	1	103	13	88	6
Native Spike	99	10	26	2	101	13	25	3	98	11	24	4	100	13	28	0
Method Blank	102	14	65	8	96	31	64	9	98	16	66	7	95	20	69	4

5.1.6 Recovery of Native Spikes from Distilled Water

Tables 5-5(a) to 5-5(d) present summaries of the native spike recoveries from distilled water samples for each compound group. Where no data is presented, spiking of the compound in question was not done.

A system was established by the MOE to use the analytical QA/QC results to identify the qualitative and quantitative applicability of the analytical results. Each contaminant was given a code, which was used to label the value of the result in qualitative and quantitative terms. The codes describe recovery criteria, based on spiking of a native compound into a distilled water sample. If spiking of this native compound was not done, the code used was based on historical recovery data from MOE LSB.

The QA/QC codes and associated recovery criteria, as established by the MOE, are:

QA/QC Code	Recovery Criteria
1	The average recovery of the native compound in distilled water samples was within 50 and 150 percent inclusive, and 70 percent or more of individual recovery data were within 50 and 150 percent.
2	The average recovery of the native compound in distilled water samples and individual percent recovery data do not fit the criteria for 1, 3, 4 and 5.
3	The average recovery of the native compound in distilled water samples is either less than 30 percent, or, more than 30 percent of individual recovery data are less than 30 percent.
4	The average recovery in distilled water samples is greater than 150 percent, or, more than 30 percent of individual percent recovery data are greater than 150 percent.
5	More than 30 percent of individual recovery data are less than 30 percent, and, more than 30 percent of individual recovery data are greater than 150 percent.
0	Analyzed by MOE LSD using internal QA/QC procedures

TABLE 5-5a)

SUMMARY OF RECOVERY OF NATIVE BASE/NEUTRAL AND ACID EXTRACTABLE COMPOUND SPIKES FROM FROM DISTILLED WATER SAMPLES

Compound Code	Compound Name	% Recovery Data Obtained In Distilled Water Samples Spiked With Native Compounds: AVG. % R	STD. DEV OF % R	# DATA	# USED DATA	% USED DATA	# DATA <30% REC	% DATA <30% REC	# DATA >150% REC	% DATA >150% REC	QA Code
X3245	2,4,5-TRICHLOROPHENOL	68.7	22.5	71	52	73.2	1	1.4	0	0.0	1
X3246	2,4,6-TRICHLOROPHENOL	83.0	16.0	68	66	97.1	0	0.0	0	0.0	1
PM24DP	2,4-DICHLOROPHENOL	75.6	21.6	68	64	94.1	2	2.9	0	0.0	1
PM24MP	2,4-DIMETHYLPHENOL	57.0	25.0	68	43	63.2	10	14.7	0	0.0	2
PM24NP	2,4-DINITROPHENOL			0							3
PM24DT	2,4-DINITROTOLUENE	96.0	16.0	68	68	100.0	0	0.0	0	0.0	1
PM26DT	2,6-DINITROTOLUENE	89.0	16.0	68	67	98.5	0	0.0	0	0.0	1
X30010	2-CHLOROPHENOL	67.0	22.0	68	50	73.5	3	4.4	0	0.0	1
PM46DP	2-METHYL4,6-DINITROPHENOL	98.0	66.0	68	33	48.5	15	22.1	16	23.5	2
PM2NP	2-NITROPHENOL	76.0	21.0	68	61	89.7	0	0.0	0	0.0	1
PM4BPE	4-BROMOPHENYLPHENYLETHER	86.0	17.0	68	66	97.1	0	0.0	0	0.0	1
PM4CPE	4-CHLOROPHENYLPHENYLETHER	83.0	18.0	68	64	94.1	0	0.0	0	0.0	1
PM4NP	4-NITROPHENOL	47.0	19.0	68	32	47.1	11	16.2	0	0.0	2
PNACNE	ACENAPHTHENE	81.0	17.0	68	66	97.1	0	0.0	0	0.0	1
PNACNY	ACENAPHTHYLENE	84.0	19.0	68	65	95.6	0	0.0	0	0.0	1
PMANAA	ALPHA-NAPHTHYLAMINE	74.0	41.0	68	47	69.1	7	10.3	3	4.4	1
P2AMET	AMETRYNE	89.0	16.0	68	66	97.1	0	0.0	0	0.0	1
PNANTR	ANTHRACENE	89.0	15.0	68	67	98.5	0	0.0	0	0.0	1
P2ATRA	ATRAZINE	104.0	42.0	68	55	80.9	3	4.4	9	13.2	1
PNBAA	BENZO(a)ANTHRACENE	86.0	21.0	68	65	95.6	0	0.0	0	0.0	1
PNBAP	BENZO(a)PYRENE	83.5	16.8	71	68	95.8	1	1.4	1	1.4	1
PNBBFA	BENZO(b)FLUORANTHENE	86.0	22.0	68	65	95.6	0	0.0	1	1.5	1
PNGHIP	BENZO(g,h,i)PERYLENE	81.0	25.0	68	60	88.2	0	0.0	1	1.5	1
PNBKF	BENZO(k)FLUORANTHENE	84.0	19.0	68	64	94.1	0	0.0	1	1.5	1
PMBNAA	Beta-NAPHTHYLAMINE	72.0	29.0	68	49	72.1	3	4.4	0	0.0	1
PNBIPH	BIPHENYL	79.0	17.0	68	66	97.1	0	0.0	0	0.0	1
PMB2EM	Bis(2-CHLOROETHOXY) METHANE	73.0	20.0	68	62	91.2	0	0.0	0	0.0	1
PMB2IE	Bis(2-CHLOROIPROPYL) ETHER	71.0	24.0	68	53	77.9	1	1.5	0	0.0	1
PMBEHP	Bis-2-ETHYLHEXYLPHTHALATE	192.0	133.0	68	36	52.9	0	0.0	31	45.6	4
PMB2NE	Bis-(2-CHLOROMETHYL) ETHER			0							2
PMBBP	BUTYLBENZYLPHTHALATE	91.0	24.0	68	66	97.1	0	0.0	1	1.5	1
PN2CNA	CHLORONAPHTHALENE	76.0	23.0	68	63	92.6	3	4.4	0	0.0	1
PNCHRY	CHRYSENE	87.0	22.0	68	64	94.1	0	0.0	1	1.5	1
P4DIAZ	DIAZINON	90.0	22.0	68	63	92.6	0	0.0	0	0.0	1
PNDAHA	DIBENZO(a,h)ANTHRACENE	81.0	19.0	68	64	94.1	0	0.0	0	0.0	1
PODICH	DICHLORAN	91.0	17.0	68	67	98.5	0	0.0	1	1.5	1
PMDEP	DIETHYL PHTHALATE	96.0	30.0	68	65	95.6	0	0.0	2	2.9	1
PMDMP	DIMETHYL PHTHALATE	90.0	18.0	68	66	97.1	0	0.0	0	0.0	1
PMDPE	DIPHENYL ETHER	79.0	17.0	68	65	95.6	0	0.0	0	0.0	1
PMDNBP	DI-N-BUTYLPHTHALATE	91.0	20.0	68	66	97.1	0	0.0	0	0.0	1
PMDNOP	DI-N-OCTYLPHTHALATE	93.0	23.0	68	66	97.1	0	0.0	1	1.5	1
PNFLAN	FLUORANTHENE	87.0	16.0	68	67	98.5	0	0.0	0	0.0	1
PNFLUO	FLUORENE	85.0	15.0	68	67	98.5	0	0.0	0	0.0	1
PNINP	IDENO(1,2,3-cd)PYRENE	81.0	20.0	68	63	92.6	0	0.0	0	0.0	1
P4MALA	MALATHION	92.0	15.0	68	68	100.0	0	0.0	0	0.0	1
P4MPAR	METHYLPARATHION	91.0	18.0	68	67	98.5	0	0.0	0	0.0	1
PMMCRE	M-CRESOL	77.0	30.0	71	57	80.3	3	4.2	3	4.2	1
PNNAPH	NAPHTHALENE	76.3	19.1	71	68	95.8	2	2.8	0	0.0	1
PMNITB	NITROBENZENE	74.9	22.2	71	59	83.1	3	4.2	0	0.0	1
PMNND	N-NITROSODIPHENYLAMINE	90.0	17.0	68	66	97.1	0	0.0	0	0.0	1
PMNNP	N-NITROSODI-NPROPYLAMINE	79.3	29.7	71	58	81.7	6	8.5	2	2.8	1
PMOCRE	O-CRESOL	41.0	19.0	68	19	27.9	20	29.4	0	0.0	2
P4EPAR	PARATHION ETHYL	91.0	19.0	68	66	97.1	0	0.0	1	1.5	1
X3PCPH	PENTACHLOROPHENOL	65.8	42.3	71	51	71.8	19	26.8	1	1.4	1
PNPHEN	PHENANTHRENE	88.0	17.0	68	65	95.6	0	0.0	0	0.0	1
PMPHEN	PHENOL	40.0	15.0	68	17	25.0	19	27.9	0	0.0	2
PNPYR	PYRENE	87.0	17.0	68	67	98.5	0	0.0	0	0.0	1
PMPCMC	P-CHLORO-M-CREOSOL	86.0	17.0	68	66	97.1	0	0.0	0	0.0	1
PMPCRE	P-CRESOL	1.0	7.0	68	1	1.5	67	98.5	0	0.0	3
POTOC	TRI-O-CRESYL PHOSPHATE	92.0	25.0	68	66	97.1	0	0.0	0	0.0	1

TABLE 5-5b)
SUMMARY OF RECOVERY OF NATIVE DIOXIN/FURAN COMPOUND SPIKES FROM DISTILLED WATER SAMPLES

	Compound Name	AVG. % R	STD. DEV. OF % R	# DATA	# USED DATA	% USED DATA	# DATA <30% REC	% DATA <30% REC	# DATA >150% REC	% DATA >150% REC	QA Code
	% Recovery Data Obtained in Distilled Water Samples Spiked With Native Compounds										
P97CDD	HEPTACHLORODIBENZODIOXIN	79.0	26.7	12	10	83.3	0	0.0	0	0	1
P97CDF	HEPTACHLORODIBENZOFURAN	101.0	39.7	12	11	91.7	0	0.0	1	8.33	1
P96CDD	HEXACHLORODIBENZODIOXIN	62.0	21.5	12	8	66.7	0	0.0	1	8.33	2
P96CDF	HEXACHLORODIBENZOFURAN	80.0	28.9	12	11	91.7	0	0.0	0	0	1
P98CDD	OCTACHLORODIBENZODIOXIN	83.0	36.8	12	10	83.3	0	0.0	0	0	1
P98CDF	OCTACHLORODIBENZOFURAN	78.0	26.4	12	11	91.7	0	0.0	0	0	1
P95CDD	PENTACHLORODIBENZODIOXIN	62.0	21.5	12	8	66.7	0	0.0	0	0	2
P95CDF	PENTACHLORODIBENZOFURAN	71.0	24.7	12	11	91.7	0	0.0	0	0	1
P94CDD	TETRACHLORODIBENZODIOXIN	66.0	21.9	12	10	83.3	1	8.3	0	0	1
P94CDF	TETRACHLORODIBENZOFURAN	54.0	31.4	12	7	58.3	2	16.7	0	0	2

TABLE 5-5c)
SUMMARY OF RECOVERY OF NATIVE PESTICIDE/HERBICIDE COMPOUND SPIKES FROM DISTILLED WATER SAMPLES

Compound Code	Compound Name	AVG. % R	STD. DEV. OF % R	# DATA	# USED DATA	% USED DATA	# DATA <30% REC	% DATA <30% REC	# DATA >150% REC	% DATA >150% REC	QA Code
	% Recovery Data Obtained In Distilled Water Samples Spiked With Native Compounds										
X2124	1,2,4-TRICHLOROBENZENE	27.8	18.4	63	31	49.2	13	20.6	0	0.00	3
P3245T	2,4,5-TRICHLOROPHENOXYACETIC ACID	13.0	45.8	46	1	2.2	45	97.8	0	0.00	3
P324D	2,4-DICHLOROPHENOXYACETIC ACID	2.4	4.9	46	1	2.2	45	97.8	0	0.00	3
P1ALDR	ALDRIN	80.6	87.4	63	54	85.7	8	12.7	0	0.00	1
P1BHCA	Alpha-BHC	77.8	32.1	63	50	79.4	4	6.3	1	1.59	1
P1CHLA	Alpha-CHLORDANE	85.8	39.2	61	50	82.0	4	6.6	3	4.92	1
P1BHCB	Beta-BHC	76.3	30.0	63	52	82.5	4	6.3	1	1.59	1
P0CAPN	CAPTAN	57.0	59.1	48	21	43.8	18	37.5	1	2.08	3
P1BHCD	Delta-BHC	72.9	40.6	62	43	69.4	11	17.7	1	1.61	1
P1DIEL	DIELDRIN	64.7	39.1	55	32	58.2	14	25.5	1	1.82	2
P1ENDA	ELDRIN ALDEHYDE	48.6	29.8	21	8	38.1	6	28.6	0	0.00	2
P1END1	ENDOSULFAN I	66.4	44.1	55	34	61.8	17	30.9	4	7.27	3
P1END2	ENDOSULFAN II	52.2	37.2	62	41	66.1	21	33.9	0	0.00	3
P1ENDS	ENDOSULFAN SULPHATE	55.8	40.7	65	37	56.9	20	30.8	0	0.00	3
P1ENDR	ENDRIN	55.3	40.8	62	31	50.0	23	37.1	1	1.61	3
P1BHCG	Gamma-BHC	65.8	33.0	62	41	66.1	10	16.1	1	1.61	2
P1CHLG	Gamma-CHLORDANE	84.6	41.7	62	48	77.4	10	16.1	3	4.84	1
P1HEPT	HEPTACHLOR	20.3	19.5	63	5	7.9	50	79.4	0	0.00	3
P1HEPE	HEPTACHLOREPOXIDE	63.8	38.2	57	35	61.4	16	28.1	1	1.75	2
X2HCB	HEXACHLOROBENZENE	64.8	27.1	63	40	63.5	6	9.5	1	1.59	2
X1HCBD	HEXACHLOROBUTADIENE	29.7	14.5	62	3	4.8	29	46.8	0	0.00	3
X1HCCP	HEXACHLOROCYCLOPENTADIENE	42.3	44.4	43	10	23.3	23	53.5	3	6.98	3
X2HCE	HEXACHLOROETHANE	28.3	13.2	63	2	3.2	34	54.0	0	0.00	3
P1DMDT	METHOXYCHLOR	57.8	35.7	60	46	76.7	17	28.3	1	1.67	1
P1MIRX	MIREX	63.0	51.0	63	51	81.0	4	6.3	0	0.00	1
P1PMIR	MIREX PHOTO	64.0	41.1	61	33	54.1	17	27.9	1	1.64	2
P1OCHL	OXYCHLORDANE	84.7	50.8	62	37	59.7	8	12.9	8	12.90	2
P1PCBT	PCB, TOTAL			0							2
P0PCNB	PCNB	65.5	27.1	58	39	67.2	5	8.6	1	1.72	2
P1PPDD	PP-DDD	90.4	47.2	62	46	74.2	9	14.5	7	11.29	1
P1PPDE	PP-DDE	78.7	37.9	59	43	72.9	7	11.9	2	3.39	1
P1PPDT	PP-DDT	63.8	65.1	62	34	54.8	21	33.9	7	11.29	3
P3SILV	SILVEX	4.9	9.7	46	0	0.0	44	95.7	0	0.00	3
P1STRO	STROBANE			0							3
P1TOX	TOXAPHENE			0							3

TABLE 5-5d)
SUMMARY OF RECOVERY OF NATIVE VOLATILE ORGANIC COMPOUND SPIKES FROM DISTILLED WATER SAMPLES

Compound Code	Compound Name	% Recovery Data Obtained in Distilled Water Samples Spiked With Native Compounds									QA Code
		AVG. % R	STD. DEV. OF % R	# DATA AVE.	# USED DATA	% USED DATA	# DATA <30% REC	% DATA <30% REC	# DATA >150% REC	% DATA >150% REC	
X1111T	1,1,1-TRICHLOROETHANE	87.0	24.0	28	25	89.28	1	3.6	0	0.0	1
X11122	1,1,2,2-TETRACHLOROETHANE	80.0	19.0	27	26	96.29	0	0.0	0	0.0	1
X1112T	1,1,2-TRICHLOROETHANE	86.0	27.0	28	24	85.71	1	3.6	1	3.6	1
X111CE	1,1-DICHLOROETHANE	92.0	25.0	27	23	85.18	0	0.0	2	7.4	1
X1DCLE	1,1-DICHLOROETHENE	84.0	23.0	26	24	92.30	0	0.0	0	0.0	1
X212CB	1,2-DICHLOROBENZENE	91.0	44.0	27	24	88.88	0	0.0	1	3.7	1
X112CE	1,2-DICHLOROETHANE	84.0	22.0	27	25	92.59	1	3.7	0	0.0	1
X112CP	1,2-DICHLOROPROPANE	91.0	22.0	27	26	96.29	0	0.0	0	0.0	1
X213CB	1,3-DICHLOROBENZENE	89.0	23.0	27	26	96.29	0	0.0	0	0.0	1
X214CB	1,4-DICHLOROBENZENE	91.0	22.0	27	26	96.29	0	0.0	0	0.0	1
B1OCTE	1-OCTENE	95.0	32.0	25	23	92	0	0.0	2	8.0	1
PM2CEE	2-CHLOROETHYLVINYLETHER	89.0	28.0	17	16	94.11	0	0.0	1	5.9	1
X2CPPE	3-CHLOROPROPENE	88.0	49.0	26	19	73.07	1	3.8	3	11.5	1
X23CTO	3-CHLOROTOLUENE	89.0	11.0	19	18	94.73	0	0.0	0	0.0	1
X1ACRO	ACROLEIN										3
X1ACRY	ACRYLONITRILE										3
X1ACTO	Alpha-CHLOROTOLUENE	82.0	24.0	18	16	88.88	2	11.1	0	0.0	1
B2BENZ	BENZENE	101.0	42.0	27	23	85.18	1	3.7	3	11.1	1
B2BDCL	BROMODICHLOROBENZENE	83.0	18.0	12	11	91.66	0	0.0	0	0.0	1
X1BDCM	BROMODICHLOROMETHANE	86.0	23.0	28	25	89.28	0	0.0	0	0.0	1
X1BETH	BROMOETHANE	79.0	18.0	25	24	96	0	0.0	0	0.0	1
BRFLB	BROMOFLUOROBENZENE										2
X1BROM	BROMOFORM	83.0	19.0	28	28	100	0	0.0	0	0.0	1
X1CTET	CARBON TETRACHLORIDE	79.0	25.0	27	23	85.18	0	0.0	1	3.7	1
X2CBEN	CHLOROBENZENE	88.0	16.0	28	27	96.42	0	0.0	0	0.0	1
X1CDBM	CHLORODIBROMOMETHANE	93.0	19.0	28	26	92.85	0	0.0	0	0.0	1
X1CHLE	CHLOROETHANE	89.0	40.0	14	11	78.57	0	0.0	1	7.1	1
X1CHLO	CHLOROFORM	99.0	35.0	28	25	89.28	0	0.0	3	10.7	1
X1CHLM	CHLOROMETHANE	86.0	60.0	17		0	2	11.8	3	17.6	2
X1CDCE	Cis-1,2-DICHLOROETHYLENE	88.0	19.0	26	25	96.15	0	0.0	0	0.0	1
X113DP	Cis-1,3-DICHLOROPROPENE	87.0	19.0	26	25	96.15	0	0.0	0	0.0	1
X1DCFM	DICHLORODIFLUOROMETHANE	79.0	37.0	21	13	61.90	1	4.8	1	4.8	2
X1DCLM	DICHLOROMETHANE	100.0	37.0	28	23	82.14	1	3.6	3	10.7	1
E1DIEE	DIETHYL ETHER	97.0	27.0	24	24	100	0	0.0	0	0.0	1
B2EBNZ	ETHYLBENZENE	93.0	16.0	28	27	96.42	0	0.0	0	0.0	1
B1HEXA	HEXANE	103.0	43.0	28	21	75	0	0.0	4	14.3	1
L1HEX	HEXANOL	66.0	20.0	3	2	66.66	0	0.0	0	0.0	2
B2MPXY	M-, and P-XYLENES	94.0	16.0	26	26	100	0	0.0	0	0.0	1
B2OXYL	O-XYLENE	95.0	20.0	20	20	100	0	0.0	0	0.0	1
B2STYR	STYRENE	91.0	12.0	19	19	100	0	0.0	0	0.0	1
X1TETR	TETRACHLOROETHYLENE	91.0	20.0	27	26	96.29	0	0.0	0	0.0	1
B2TOLU	TOLUENE	96.0	26.0	28	26	92.85	0	0.0	1	3.6	1
X113DR	Trans-1,3-DICHLOROPROPENE	100.0	32.0	24	23	95.83	0	0.0	2	8.3	1
X1TRIC	TRICHLOROETHYLENE	87.0	23.0	27	26	96.29	1	3.7	0	0.0	1
X1TCFM	TRICHLOROFLUOROMETHANE	85.0	22.0	21	21	100	0	0.0	0	0.0	1
X1T12D	TR-1,2-DICHLOROETHYLENE	82.0	28.0	20	18	90	0	0.0	0	0.0	1
B1VBR	VINYL BROMIDE	77.0	24.0	21	20	95.23	0	0.0	0	0.0	1
X1VCL	VINYL CHLORIDE	64.0	45.0	11	5	45.45	1	9.1	1	9.1	2

The above QA/QC codes were used by the MOE to evaluate the applicability of the data, as follows:

QA/QC Code	Data Application
0, 1	Result can be used quantitatively.
2	The result can be used to confirm either the presence or absence of the contaminant, but may not be used quantitatively.
3	If the compound was detected in a sample stream, its presence can be confirmed and the reported concentration is a minimum. However, if it was not detected, its absence cannot be confirmed.
4	If the compound was not detected in a sample stream its absence can be confirmed. However, if it was detected, its presence cannot be confirmed.
5	Neither the absence nor presence of the compound detected or not detected in a sample stream can be confirmed, ie. no conclusions may be made.

The above criteria were applied to all of the contaminants analyzed. The majority of contaminants fell into criteria 1, 2 and 3. Only one contaminant (bis-2-ethylhexyl phthalate) fell into criteria 4 and the results for this compound were previously invalidated using the method blank criterion. There were no contaminants which fell into criteria 5.

5.1.7 MOE LSB Spiking

Duplicate samples were sent from the field to MOE LSB for native compound spiking before being sent to the contract laboratory for analysis, as described in Section 3.2.

The results from these tests were used for observation purposes and were not used for quality control or quality assurance purposes in this study. These results are presented in a separate report by the MOE LSB (Ref. 6).

5.2 Individual WPCP Reports

5.2.1 Background Data

Individual plant background data that was collected for the study included plant historical (1981 - 1985) performance summaries, raw water sources and estimated quantities, premonitoring operational data and design information.

Appendix A contains a sub-appendix for each plant in the study, containing (where available) the above background data.

5.2.2 Sampling Program Data

The results of the sampling program contaminant analyses were summarized in individual reports prepared for each plant. Each individual plant report consists of a number of tables, one for each stream sampled at the plant, including raw sewage, final effluent (primary, secondary or lagoon), raw sludge and treated sludge. If there was a recycle stream, an additional table presents this analytical data. Also, the raw sewage results presented are after the recycle contribution in terms of flows and contaminant concentrations has been subtracted.

The individual plant tables for each stream summarize the analytical data for each compound using the following parameters:

- Compound name
- Compound code
- QA/QC code (Section 5.1.2)
- Number of samples analyzed
- Number of samples where compound was detected
- The frequency of detection of the compound in all samples analyzed
- The maximum concentrations analyzed

In addition, two statistical parameters describe the results; the geometric mean and spread factor. For the purpose of calculating the geometric mean and spread factor in cases where the analytical result was below the associated DL, the value below the DL was assumed to be one half of the DL.

For purposes of comparison, individual plant analytical summary tables include results for all of the plants (global) for a specific stream type.

The individual plant reports containing summary analytical data table for each stream are presented in Appendix A.

5.3 Summary of Sampling Program Results

5.3.1 Data Presentation

In order to satisfy the objectives of this study, it was necessary to summarize the analytical data on a combined WPCP or global level.

The global data base for a particular sample type was made up of all the data obtained from the analysis of all relevant samples at all WPCPs. For the purposes of these summaries, each sample (24 hour composite or 5 day composite) was considered independent of the number of samples taken at the plant or the number of sampling periods at the plant.

A global summary table was prepared for each of the following sample types:

- Raw sewage (corrected for the effects of included recycle streams)
- Primary effluent
- Secondary effluent
- Lagoon effluent
- Tertiary effluent
- Raw sludges
- Treated sludges

Each table includes the following:

- Compound code
- Compound name
- QA/QC Code (Section 5.1.2)
- Number of samples analyzed for the compound
- Number of samples in which the compound was detected
- The frequency of detection of the compound in all samples
- The maximum concentration analyzed
- The minimum concentration above the DL

- The number of plants at which the compound was analyzed

- The plant prevalence ie. the percentage of the total number of plants where the compound was detected in at least one sample

In addition, global geometric means and spread factors were calculated, based on the assumptions described in subsection 5.2.2 for values less than the DL.

Also included in the summary tables for liquid streams (ie. raw sewage and effluents) is the compound DL. As previously discussed, this value occasionally varied during the laboratory analyses within the stream type depending on a number of factors. The DL values presented in the summary tables are the limits for over 90 percent of the samples in a stream type. For approximately 10 percent of the samples the analytical laboratory was able to achieve reliable results below those DLs. This will explain the reason that in some cases the minimum reported concentrations presented are lower than the "typical" DL.

For sludges, the DLs used in analyses were based on the liquid sludge sample analyses. Since the contaminant concentrations presented for sludges are on a dry weight basis, the DLs cannot be used for comparative purposes, and are therefore not presented.

5.3.2 Contaminants Not Detected in Any Sample Type

Table 5-6 lists those compounds that were never detected at concentrations above the DLs in any liquid or sludge sample at any of the 37 WPCPs sampled. The list has been partitioned into compounds that are confirmed as not detected and compounds which on the basis of QA/QC results cannot be confirmed as not detected.

In total, 34 compounds were never detected in any sample type, 4 of these were not confirmed. Of the total number, 17 were base neutral and acid extractable compounds, 13 were volatile organic compounds, 3 were pesticide and herbicide compounds and 1 was Tetrachlorodibenzodioxin. There are no metals on this list.

5.3.3 Summary of Contaminants in Raw Wastewater

Table 5-7(a) presents the compounds that were not detected above the DL in any raw wastewater sample. A total of 59 compounds were not detected, including 4 that were not confirmed. Also indicated in this Table are all compounds that were not detected in any stream type (Table 5-6).

TABLE 5-6 - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN ANY STREAM

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
P2ATRA	ATRAZINE	PMPCRE	P-CRESOL
P4DIAZ	DIAZINON		
P4EPAR	PARATHION ETHYL		
P4MALA	MALATHION		
P4MPAR	METHYLPARATHION		
PM24NP	2,4-DINITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE		
PMBNAA	Beta-NAPHTHYLAMINE		
PN2CNA	CHLORONAPHTHALENE		
PNACNE	ACENAPHTHENE		
PNDAHA	DIBENZO(a,h)ANTHRACENE		
PNGHIP	BENZO(g,h,i)PERYLENE		
PNINP	IDENO(1,2,3-cd)PYRENE		
PODICH	DICHLORAN		
POTOC	TRI-O-CRESYL PHOSPHATE		
X3245	2,4,5-TRICHLOROPHENOL		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN		
	PESTICIDES, HERBICIDES, PCBS		
P1STRO	STROBANE	POCAPN	CAPTAN
		X1HCBD	HEXACHLOROBUTADIENE
	VOLATILES		
B1VBR	VINYL BROMIDE	X1ACRY	ACRYLONITRILE
PM2CEE	2-CHLOROETHYLVINYLETHER		
X11122	1,1,2,2-TETRACHLOROETHANE		
X1112T	1,1,2-TRICHLOROETHANE		
X1BETH	BROMOETHANE		
X1BROM	BROMOFORM		
X1CHLE	CHLOROETHANE		
X1CHLM	CHLOROMETHANE		
X1T12D	TR-1,2-DICHLOROETHYLENE		
X1TCFM	TRICHLOROFLUOROMETHANE		
X1VCL	VINYL CHLORIDE		
X2CPPE	3-CHLOROPROPENE		

TABLE 5-7 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN RAW SEWAGE

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
BEUT	BERYLLIUM,UNFILT.TOTAL		
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
P2AMET	AMETRYNE	PMPCRE	P-CRESOL*
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DT	2,4-DINITROTOLUENE		
PM24NP	2,4-DINITROPHENOL*		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDPE	DIPHENYL ETHER		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNACNY	ACENAPHTHYLENE		
PNANTH	ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBIPH	BIPHENYL		
PNCHRY	CHRYSENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X3245	2,4,5-TRICHLOROPHENOL*		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P95CDD	PENTACHLORODIBENZODIOXIN		
P95CDF	PENTACHLORODIBENZOFURAN		
P96CDD	HEXACHLORODIBENZODIOXIN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDD	HEPTACHLORODIBENZODIOXIN		
P97CDF	HEPTACHLORODIBENZOFURAN		
	PESTICIDES, HERBICIDES, PCBS		
P0PCNB	PCNB	P0CAPN	CAPTAN*
P1ENDA	ELDRIN ALDEHYDE	X1HCBD	HEXACHLOROBUTADIENE*
P1STRO	STROBANE*		
P1TOX	TOXAPHENE		
	VOLATILES		
B1OCTE	1-OCTENE	X1ACRY	ACRYLONITRILE*
B1VBR	VINYL BROMIDE*		
E1DIEE	DIETHYL ETHER		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X113DR	TRANS-1,3-DICHLOROPROPENE		
X1ACTO	ALPHA-CHLOROTOLUENE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1VCL	VINYL CHLORIDE*		
X213CB	1,3-DICHLOROBENZENE		
X214CB	1,4-DICHLOROBENZENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

A summary of the compounds that were detected in any raw sewage sample (all WPCPs) is presented in Table 5-7(b). A total of 85 organic contaminants, 14 metals and cyanide were detected at least once in raw sewage samples. However, only 7 metals (Al, Sr, Zn, Hg, Cu, Ni and Cr), 2 base neutral and acid extractable compounds (M-cresol and phenol) and two pesticides and herbicides (2,4-Dichlorophenoxyacetic acid and gamma-BHC) were found in the raw sewage streams at more than 50 percent of WPCPs. The most prevalent volatile organic compounds were detected in raw sewage at fewer than 40 percent of the 37 plants, and the most prevalent dioxin/furans at fewer than 11 percent of plants.

All detected volatile compounds, dioxin/furans compounds and all but the 2 pesticides and herbicides and 2 base neutral and acid extractable compounds (mentioned above) were detected in less than 20 percent of the samples. Metals were most frequently detected contaminant group.

5.3.4 Summary of Contaminants in Primary Effluents

Table 5-8(a) presents the contaminants that were not detected in any primary effluent samples from any of the 7 primary treatment plants. There were a total of 109 compounds not detected, including 7 that were not confirmed. Also indicated in the Table are the 34 compounds that were not detected in any sample at any plant.

A summary of the parameters detected in any primary effluent is presented in Table 5-8(b). A total of 33 organic contaminants, 13 metals and cyanide were detected at least once in the primary effluents.

Four of the 6 base neutral and acid extractable compounds, 4 of the 15 pesticides and herbicides, and 4 of 10 volatile organic compounds were detected in at least 3 of the 7 primary WPCPs. Metals were the most prevalent contaminant with 12 metals detected at at least 3 plants. Dioxin/furan compounds were only detected at 2 plants.

As noted, metals were the most frequently detected contaminants. Six metals (Zn, Sr, Hg, Al, Cr, Cu) were detected in greater than 60 percent of all primary effluent samples. Only one base neutral and acid extractable compound (M-cresol) two pesticides and herbicides (gamma-BHC and 2,4-Dichlorophenoxyacetic acid) and 1 volatile organic compound (Tetrachloroethylene) were present at least 40 percent of samples. The most frequently detected dioxin compound (Octachlorodibenzodioxin) was detected in only 25 percent of the samples.

TABLE 5-7 b - GLOBAL SUMMARY OF CONTAMINANTS IN RAW SEWAGE

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
CONVENTIONAL														
DOC	DISSOLVED ORGANIC CARBON	mg/L	0	271	271	100.0	37	37	100.0	22.39	1.81	184.00	1.50	1.00
NNTKUR	NITROGEN-TOT KJEL,UNF.TOT	mg/L	0	273	273	100.0	37	37	100.0	25.44	1.47	76.50	1.20	0.10
PH	(-LOG(H+(CONCN))		0	275	275	100.0	37	37	100.0	6.90	1.05	9.27	6.09	1.00
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	248	248	100.0	30	30	100.0	5.18	1.51	17.90	0.51	0.01
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0	274	275	99.6	37	37	100.0	15.37	1.69	43.10	4.55	0.20
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	266	267	99.6	37	37	100.0	140.23	1.93	802.00	11.00	1.00
RSP	RESIDUE, PARTICULATE	mg/L	0	266	267	99.6	37	37	100.0	126.88	1.93	667.00	6.10	1.00
COD	CHEMICAL OXYGEN DEMAND	mg/L	0	258	260	99.2	37	37	100.0	287.75	1.82	1620.00	12.00	5.00
RSPLOI	RESIDUE,PAR LOSS ON IGNI.	mg/L	0	89	90	98.9	18	18	100.0	100.84	1.78	259.00	24.62	0.00
NNO2FR	NITRITE,FILT. REACT.	mg/L	0	58	271	21.4	19	37	51.4	0.01	2.98	0.97	0.01	0.01
PHNOL	PHENOLICS (4AAP)	mg/L	0	37	275	13.5	14	37	37.8	0.31	2.05	16.01	0.58	0.50
NNOTFR	NITRATES,TOTAL FILT REAC.	mg/L	0	28	275	10.2	12	37	32.4	0.05	2.33	13.40	0.05	0.05
METALS AND CYANIDE														
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	318	319	99.7	37	37	100.0	370.70	2.14	2250.00	60.00	10.00
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	48	49	98.0	34	35	97.1	110.60	2.28	660.00	30.00	10.00
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	315	322	97.8	37	37	100.0	211.00	2.94	5300.00	19.50	20.00
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	274	283	96.8	37	37	100.0	0.23	2.11	1.60	0.02	0.01
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	306	322	95.0	36	37	97.3	1000.10	2.65	22957.80	101.60	20.00
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	237	322	73.6	33	37	89.2	51.10	3.44	820.00	10.00	10.00
NIUT	NICKEL,UNFILT TOTAL	ug/L	0	103	322	32.0	20	37	54.1	38.80	2.70	1469.90	20.00	10.00
CCNFUR	CYANIDE-FREE,UNFILT.REAC.	ug/L	0	82	271	30.3	12	37	32.4	1.90	6.88	19000.00	3.00	1.00
AGUT	SILVER,UNFILT.TOTAL	ug/L	0	82	321	25.6	28	37	75.7	10.40	2.55	90.00	8.20	10.00
COUT	COBALT,UNFILT TOTAL	ug/L	0	82	322	25.5	31	37	83.8	9.30	2.31	80.00	4.50	10.00
CDUT	CADMIUM,UNFILT.TOTAL	ug/L	0	76	322	23.6	26	37	70.3	6.50	2.09	259.20	3.00	3.00
PBUT	LEAD,UNFILT.TOTAL	ug/L	0	57	322	17.7	19	37	51.4	59.50	1.86	1203.00	60.00	30.00
MOUT	MOLYBDENUM,UNFILT TOTAL	ug/L	0	41	321	12.8	21	37	56.8	12.40	1.72	590.00	20.00	10.00
SEUT	SELENIUM,UNFILT TOTAL	ug/L	0	5	308	1.6	2	37	5.4	17.30	2.07	80.00	30.00	30.00
ASUT	ARSENIC,UNFILT TOTAL	ug/L	0	3	308	1.0	1	37	2.7	16.80	1.83	60.00	60.00	30.00
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PMMCRE	M-CRESOL	ug/L	1	167	275	60.7	32	37	86.5	25.59	3.45	783.95	0.18	15.00
PMPHEN	PHENOL	ug/L	2	118	275	42.9	29	37	78.4	14.52	2.46	276.20	9.97	15.00
PMBBP	BUTYLBENZYLPHTHALATE	ug/L	1	34	275	12.4	14	37	37.8	5.85	1.66	82.90	10.10	10.00
PNNAPH	NAPHTHALENE	ug/L	1	16	275	5.8	8	37	21.6	5.37	1.47	46.90	10.30	10.00
PNPHEN	PHENANTHRENE	ug/L	1	7	275	2.6	4	37	10.8	5.17	1.35	39.30	2.20	10.00
PMOCRE	O-CRESOL	ug/L	2	6	275	2.2	3	37	8.1	7.72	1.39	216.50	15.30	15.00
X3PCPH	PENTACHLOROPHENOL	ug/L	1	5	275	1.8	4	37	10.8	12.94	1.42	120.80	29.60	25.00
PMDMP	DIMETHYL PHTHALATE	ug/L	1	4	275	1.5	2	37	5.4	5.10	1.37	117.60	10.60	10.00
PNFLAN	FLUORANTHENE	ug/L	1	4	275	1.5	2	37	5.4	5.09	1.29	36.60	2.40	10.00
PM4NP	4-NITROPHENOL	ug/L	2	3	275	1.1	3	37	8.1	12.65	1.29	53.30	32.05	25.00
PMB2EM	BIS(2-CHLORETHOXY)METHANE	ug/L	1	2	275	0.7	2	37	5.4	5.09	1.38	106.70	47.70	10.00
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER	ug/L	2	2	275	0.7	2	37	5.4	7.61	1.34	101.50	39.40	15.00
PMNNP	N-NITROSO-DI-NPROPYLAMINE	ug/L	1	2	275	0.7	2	37	5.4	5.09	1.37	103.90	39.00	10.00
PM24DP	2,4-DICHLOROPHENOL	ug/L	1	1	275	0.4	1	37	2.7	12.57	1.29	76.80	76.80	25.00
PM24MP	2,4-DIMETHYLPHENOL	ug/L	2	1	275	0.4	1	37	2.7	12.54	1.27	33.90	33.90	25.00
PM26DT	2,6-DINITROTOLUENE	ug/L	1	1	275	0.4	1	37	2.7	7.54	1.28	36.90	36.90	15.00
PM2NP	2-NITROPHENOL	ug/L	1	1	275	0.4	1	37	2.7	12.53	1.26	29.40	29.40	25.00
PM46DP	2-METHYL4,6-DINITROPHENOL	ug/L	2	1	275	0.4	1	37	2.7	12.57	1.29	79.40	79.40	25.00
PM4BPE	4-BROMOPHENYLPHENYLETHER	ug/L	1	1	275	0.4	1	37	2.7	7.58	1.35	181.40	181.40	15.00
PM4CPE	4 CHLOROPHENYLPHENYLETHER	ug/L	1	1	275	0.4	1	37	2.7	5.05	1.33	95.50	95.50	10.00

TABLE 5-7 b - GLOBAL SUMMARY OF CONTAMINANTS IN RAW SEWAGE

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER	ug/L	1	1	275	0.4	1	37	2.7	5.05	1.35	124.00	124.00	10.00
PMNITB	NITROBENZENE	ug/L	1	1	275	0.4	1	37	2.7	5.03	1.29	28.96	28.96	10.00
PMNND	N-NITROSO-DI-PHENYLAMINE	ug/L	1	1	275	0.4	1	37	2.7	5.05	1.35	121.60	121.60	10.00
PMPCMC	P-CHLORO-M-CRESOL	ug/L	1	1	275	0.4	1	37	2.7	12.59	1.30	104.70	104.70	25.00
PNBAA	BENZO(A)ANTHRACENE	ug/L	1	1	275	0.4	1	37	2.7	5.03	1.29	37.60	37.60	10.00
PNBBFA	BENZO(B)FLUORANTHENE	ug/L	1	1	275	0.4	1	37	2.7	5.01	1.27	14.00	14.00	10.00
PNBKF	BENZO(K)FLUORANTHENE	ug/L	1	1	275	0.4	1	37	2.7	5.03	1.29	33.30	33.30	10.00
PNFLUO	FLUORENE	ug/L	1	1	275	0.4	1	37	2.7	5.02	1.28	24.50	24.50	10.00
PNPYR	PYRENE	ug/L	1	1	275	0.4	1	37	2.7	7.51	1.26	15.00	15.00	15.00
X3001O	2-CHLOROPHENOL	ug/L	0	1	275	0.4	1	37	2.7	12.53	1.26	32.20	32.20	25.00
X3246	2,4,6-TRICHLOROPHENOL	ug/L	1	1	275	0.4	1	37	2.7	12.53	1.26	30.50	30.50	25.00
DIOXINS AND FURANS														
P98CDD	OCTACHLORODIBENZODIOXIN	ng/L	1	4	54	7.4	4	37	10.8	0.87	3.66	28.00	0.73	1.00
P94CDF	TETRACHLORODIBENZOFURAN	ng/L	2	1	54	1.9	1	37	2.7	0.41	3.08	4.80	4.80	0.20
P98CDF	OCTACHLORODIBENZOFURAN	ng/L	1	1	54	1.9	1	37	2.7	0.79	2.87	3.00	3.00	1.00
PESTICIDES,HERBICIDES,PCBS														
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	214	276	77.5	37	37	100.0	0.13	3.72	2.60	0.00	0.04
P1BHCO	GAMMA-BHC(HEXACHLORCYCLHEXANE)	ug/L	2	143	276	51.8	35	37	94.6	0.02	2.29	2.70	0.01	0.02
P1DMDT	METHOXYCHLOR	ug/L	1	47	276	17.0	16	37	43.2	0.08	3.14	5.90	0.10	0.10
P1PCBT	PCB, TOTAL	ug/L	2	42	276	15.2	17	37	46.0	0.06	2.31	4.50	0.08	0.08
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	35	276	12.7	15	37	40.5	0.01	2.48	2.26	0.02	0.02
P1BHCB	BETA-BHC (HEXACHLORCYCLHEXANE)	ug/L	1	32	276	11.6	13	37	35.1	0.01	1.66	0.13	0.02	0.02
P3SILV	SILVEX	ug/L	3	28	276	10.1	15	37	40.5	0.06	1.68	1.00	0.08	0.10
P3245T	2,4,5-TRICLORPHENOXYACETIC ACID	ug/L	3	22	276	8.0	14	37	37.8	0.06	1.60	0.73	0.07	0.10
P1BHCA	ALPHA BHC(HEXACHLORCYCLHEXANE)	ug/L	1	16	276	5.8	7	37	18.9	0.01	1.50	0.10	0.02	0.02
P1PPDE	PP-DDE	ug/L	1	15	276	5.4	9	37	24.3	0.01	1.74	5.80	0.01	0.02
P1ENDS	ENDOSULFAN SULPHATE	ug/L	3	13	276	4.7	6	37	16.2	0.04	1.56	0.99	0.12	0.08
X2HCB	HEXACHLOROBENZENE	ug/L	2	11	276	4.0	7	37	18.9	0.01	1.39	0.10	0.02	0.02
P1END2	ENDOSULFAN II	ug/L	3	10	276	3.6	8	37	21.6	0.01	1.42	0.15	0.02	0.02
P1HEPT	HEPTACHLOR	ug/L	3	10	276	3.6	7	37	18.9	0.01	1.48	0.22	0.03	0.02
P1CHLG	GAMMA CHLORDANE	ug/L	1	9	276	3.3	6	37	16.2	0.01	1.49	2.10	0.02	0.02
P1PPDT	PP-DDT	ug/L	3	9	276	3.3	7	37	18.9	0.04	1.35	0.95	0.08	0.08
P1DIEL	DIELDRIN	ug/L	2	8	276	2.9	7	37	18.9	0.01	1.28	0.04	0.02	0.02
P1CHLA	ALPHA CHLORDANE	ug/L	1	7	276	2.5	5	37	13.5	0.01	1.46	2.00	0.02	0.02
P1MIRX	MIREX	ug/L	1	6	276	2.2	4	37	10.8	0.01	1.28	0.20	0.02	0.02
P1PPDD	PP-DDD	ug/L	1	6	276	2.2	5	37	13.5	0.01	1.38	0.34	0.02	0.02
P1ENDR	ENDRIN	ug/L	3	5	276	1.8	4	37	10.8	0.01	1.34	0.25	0.03	0.02
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/L	3	5	276	1.8	5	37	13.5	0.10	1.30	0.38	0.12	0.20
X2HCE	HEXACHLOROETHANE	ug/L	3	5	276	1.8	5	37	13.5	0.01	1.26	0.09	0.02	0.02
P1END1	ENDOSULFAN I	ug/L	3	4	276	1.5	2	37	5.4	0.01	1.30	0.12	0.03	0.02
P1ALDR	ALDRIN	ug/L	1	3	276	1.1	3	37	8.1	0.01	1.21	0.04	0.02	0.02
P1HEPE	HEPTACHLOREPOXIDE	ug/L	2	2	276	0.7	2	37	5.4	0.01	1.19	0.03	0.02	0.02
P1OCHL	OXYCHLORDANE	ug/L	2	2	276	0.7	2	37	5.4	0.01	1.23	0.06	0.05	0.02
P1BHCD	DELTA BHC(HEXACHLORCYCLHEXANE)	ug/L	1	1	276	0.4	1	37	2.7	0.01	1.20	0.05	0.05	0.02
P1PMIR	MIREX PHOTO	ug/L	2	1	276	0.4	1	37	2.7	0.01	1.18	0.03	0.03	0.02

TABLE 5-7b - GLOBAL SUMMARY OF CONTAMINANTS IN RAW SEWAGE

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
VOLATILES														
B2MPXY	M-, AND P-XYLENES	ug/L	1	43	274	15.7	14	37	37.8	26.00	2.02	1700.00	3.80	40.00
B2EBNZ	ETHYLBENZENE	ug/L	1	30	274	11.0	11	37	29.7	23.50	1.75	1200.00	3.50	40.00
X1CHLO	CHLOROFORM	ug/L	1	28	274	10.2	12	37	32.4	23.90	1.75	340.00	41.00	40.00
B2OXYL	O-XYLENE	ug/L	1	25	274	9.1	9	37	24.3	22.47	1.56	570.00	4.40	40.00
X1111T	1,1,1-TRICHLOROETHANE	ug/L	1	21	274	7.7	7	37	18.9	23.18	1.74	440.00	43.42	40.00
X1TRIC	TRICHLOROETHYLENE	ug/L	1	15	274	5.5	6	37	16.2	22.59	1.82	9800.00	12.00	40.00
X1TETR	TETRACHLOROETHYLENE	ug/L	1	12	274	4.4	7	37	18.9	21.51	1.53	3000.00	29.00	40.00
B2STYR	STYRENE	ug/L	1	9	274	3.3	4	37	10.8	21.40	1.39	1208.08	43.33	40.00
X1DCLE	1,1-DICHLOROETHENE	ug/L	1	7	274	2.6	5	37	13.5	20.55	1.28	220.00	10.00	40.00
B2BDCL	BROMODICHLOROBENZENE	ug/L	1	2	274	0.7	2	37	5.4	20.55	1.12	55.00	40.00	40.00
X112CE	1,2-DICHLOROETHANE	ug/L	1	2	274	0.7	2	37	5.4	20.26	1.17	120.00	120.00	40.00
X1BDCM	BROMODICHLOROMETHANE	ug/L	1	2	274	0.7	2	37	5.4	30.10	1.10	130.00	18.00	60.00
X1CDBM	CHLORODIBROMOMETHANE	ug/L	1	2	274	0.7	2	37	5.4	20.16	1.10	67.00	56.00	40.00
X1CTET	CARBON TETRACHLORIDE	ug/L	1	2	274	0.7	2	37	5.4	20.19	1.12	99.00	57.00	40.00
L1HEX	HEXANOL	ug/L	2	1	274	0.4	1	37	2.7	1368.56	7.08	5000.00	5000.00	5000
X111CE	1,1-DICHLOROETHANE	ug/L	1	1	274	0.4	1	37	2.7	20.19	1.16	250.00	250.00	40.00
X112CP	1,2-DICHLOROPROPANE	ug/L	1	1	274	0.4	1	37	2.7	20.05	1.05	42.00	42.00	40.00
X113DP	CIS-1,3-DICHLOROPROPENE	ug/L	1	1	274	0.4	1	37	2.7	29.24	1.11	40.00	40.00	60.00
X1ACRO	ACROLEIN	ug/L	3	1	274	0.4	1	37	2.7	202.81	1.26	9200.00	9200.00	400.00
X1CDCE	CIS-1,2-DICHLOROETHYLENE	ug/L	1	1	274	0.4	1	37	2.7	20.14	1.12	130.00	130.00	40.00
X212CB	1,2-DICHLOROBENZENE	ug/L	1	1	274	0.4	1	37	2.7	20.05	1.05	42.00	42.00	40.00
X23CTO	3-CHLOROTOLUENE	ug/L	1	1	274	0.4	1	37	2.7	20.51	1.11	44.00	44.00	40.00

TABLE 5-8 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN PRIMARY EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
ASUT	ARSENIC,UNFILT.TOTAL		
BEUT	BERYLLIUM,UNFILT.TOTAL		
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
P2AMET	AMETRYNE	PMPCRE	P-CRESOL*
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DP	2,4-DICHLOROPHENOL		
PM24DT	2,4-DINITROTOLUENE		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM26DT	2,6-DINITROTOLUENE		
PM2NP	2-NITROPHENOL		
PM46DP	2-METHYL4,6-DINITROPHENOL		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PM4NP	4-NITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2EM	BIS(2-CHLORETHOXY)METHANE		
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER		
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDMP	DIMETHYL PHTHALATE		
PMDPE	DIPHENYL ETHER		
PMNITB	NITROBENZENE		
PMNND	N-NITROSO-DI-PHENYLAMINE		
PMNNP	N-NITROSO-DI-NPROPYLAMINE		
PMPCMC	P-CHLORO-M-CRESOL		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNACNY	ACENAPHTHYLENE		
PNANTH	ANTHRACENE		
PNBAA	BENZO(A)ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBBFA	BENZO(B)FLUORANTHENE		
PNBIPH	BIPHENYL		
PNBKF	BENZO(K)FLUORANTHENE		
PNCHRY	CHRYSENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNFLAN	FLUORANTHENE		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PNPHEN	PHENANTHRENE		
PNPYR	PYRENE		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X30010	2-CHLOROPHENOL		
X3245	2,4,5-TRICHLOROPHENOL*		
X3246	2,4,6-TRICHLOROPHENOL		
X3PCPH	PENTACHLOROPHENOL		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P95CDD	PENTACHLORODIBENZODIOXIN		
P95CDF	PENTACHLORODIBENZOFURAN		
P96CDD	HEXACHLORODIBENZODIOXIN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDD	HEPTACHLORODIBENZODIOXIN		
P97CDF	HEPTACHLORODIBENZOFURAN		
P98CDF	OCTACHLORODIBENZOFURAN		
	PESTICIDES, HERBICIDES, PCBS		
P0PCNB	PCNB	P0CAPN	CAPTAN*
P1ALDR	ALDRIN	P1END1	ENDOSULFAN I
P1BHCD	DELTA-BHC(HEXACHLORCYCLHEXANE)	P1ENDR	ENDRIN
P1CHLA	ALPHA-CHLORDANE	X1HCBD	HEXACHLOROBUTADIENE*
P1CHLG	GAMMA-CHLORDANE		
P1DIEL	DIELDRIN		
P1ENDA	ELDRIN ALDEHYDE		
P1HEPE	HEPTACHLOREPOXIDE		
P1OCHL	OXYCHLORDANE		
P1PMIR	MIREX PHOTO		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-8 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN PRIMARY EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	PESTICIDES, HERBICIDES, PCBS		
P1PPDD	PP-DDD		
P1PPDE	PP-DDE		
P1STRO	STROBANE*		
P1TOX	TOXAPHENE		
X2HCB	HEXACHLOROBENZENE		
	VOLATILES ORGANIC		
B1VBR	VINYL BROMIDE*	X1ACRO	ACROLEIN
B2BDCL	BROMODICHLOROBENZENE	X1ACRY	ACRYLONITRILE*
E1DIEE	DIETHYL ETHER		
L1HEX	HEXANOL		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X111CE	1,1-DICHLOROETHANE		
X112CE	1,2-DICHLOROETHANE		
X112CP	1,2-DICHLOROPROPANE		
X113DP	CIS-1,3-DICHLOROPROPENE		
X113DR	TRANS-1,3-DICHLOROPROPENE		
X1ACTO	ALPHA-CHLOROTOLUENE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CDBM	CHLORODIBROMOMETHANE		
X1CDCE	CIS-1,2-DICHLOROETHYLENE		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X213CB	1,3-DICHLOROBENZENE		
X214CB	1,4-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-8 b - GLOBAL SUMMARY OF CONTAMINANTS IN PRIMARY EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
CONVENTIONAL														
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	40	40	100.0	7	7	100.0	48.40	2.05	139.00	8.20	1.00
COD	CHEMICAL OXYGEN DEMAND	mg/L	0	40	40	100.0	7	7	100.0	108.54	1.56	376.00	50.00	5.00
DOC	DISSOLVED ORGANIC CARBON	mg/L	0	40	40	100.0	7	7	100.0	12.80	1.40	44.80	8.00	1.00
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0	40	40	100.0	7	7	100.0	10.46	1.66	21.60	2.20	0.20
NNTKUR	NITROGEN TOT KJEL,UNF TOT	mg/L	0	40	40	100.0	7	7	100.0	15.36	1.30	24.10	8.30	0.01
PH	(-LOG(H+(CONCN))		0	40	40	100.0	7	7	100.0	6.88	1.03	7.44	6.16	1.00
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	34	34	100.0	5	5	100.0	1.34	1.96	4.02	0.33	0.01
RSP	RESIDUE, PARTICULATE	mg/L	0	39	39	100.0	7	7	100.0	29.57	1.73	111.00	7.30	1.00
RSPLOI	RESIDUE,PAR.LOSS ON IGNI.	mg/L	0	10	10	100.0	2	2	100.0	28.16	1.95	76.80	12.80	0.00
TURB	TURBIDITY	mg/L	0	5	5	100.0	1	1	100.0	17.58	1.35	26.00	11.50	0.25
PHNOL	PHENOLICS (4AAP)	mg/L	0	7	40	17.5	4	7	57.1	0.06	2.01	2.60	0.11	0.10
NNO2FR	NITRITE,FILT. REACT.	mg/L	0	4	40	10.0	1	7	14.3	0.00	4.03	0.53	0.15	0.01
NNOTFR	NITRATES,TOTAL FILT REAC.	mg/L	0	4	40	10.0	1	7	14.3	0.05	3.16	1.55	0.90	0.05
METALS AND CYANIDE														
ZNUT	ZINC,UNFILT TOTAL	ug/L	0	48	48	100.0	7	7	100.0	69.80	3.04	1300.00	10.00	20.00
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	47	48	97.9	7	7	100.0	304.90	2.83	1030.00	60.00	10.00
HGUT	MERCURY,UNFILT TOTAL	ug/L	0	38	39	97.4	7	7	100.0	0.05	2.42	0.36	0.01	0.01
ALUT	ALUMINUM,UNFILT TOTAL	ug/L	0	46	48	95.8	7	7	100.0	550.00	3.45	4800.00	100.00	20.00
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	7	8	87.5	7	7	100.0	18.20	1.85	60.00	10.00	10.00
CRUT	CHROMIUM,UNFILT TOTAL	ug/L	0	29	48	60.4	6	7	85.7	10.80	1.94	40.00	10.00	10.00
CDUT	CADMIUM,UNFILT TOTAL	ug/L	0	18	48	37.5	6	7	85.7	2.50	1.96	7.00	3.00	3.00
COUT	COBALT,UNFB.T TOTAL	ug/L	0	11	48	22.9	6	7	85.7	6.50	1.58	20.00	10.00	10.00
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0	11	48	22.9	5	7	71.4	6.60	1.66	20.00	10.00	10.00
NIUT	NICKEL,UNFILT TOTAL	ug/L	0	10	48	20.8	4	7	57.1	8.70	2.86	140.00	10.00	10.00
PBUT	LEAD,UNFILT TOTAL	ug/L	0	9	48	18.8	5	7	71.4	20.80	1.94	140.00	30.00	30.00
AGUT	SILVER,UNFILT TOTAL	ug/L	0	8	48	16.7	4	7	57.1	6.40	1.61	20.00	10.00	10.00
CCNFUR	CYANIDE-FREE,UNFILT REAC.	ug/L	0	3	40	7.5	3	7	42.9	0.90	2.61	39.00	7.00	1.00
SEUT	SELENIUM,UNFILT.TOTAL	ug/L	0	1	45	2.2	1	7	14.3	16.50	1.70	30.00	30.00	30.00
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PMMCRE	M-CRESOL	ug/L	1	18	39	46.2	5	7	71.4	3.90	2.97	32.40	4.30	3.00
PMBBP	BUTYLBENZYLPHTHALATE	ug/L	1	8	39	20.5	4	7	57.1	1.42	2.10	9.20	2.10	2.00
PMPHEN	PHENOL	ug/L	2	5	39	12.8	3	7	42.9	1.78	1.60	8.70	3.40	3.00
PNNAPH	NAPHTHALENE	ug/L	1	5	39	12.8	3	7	42.9	1.13	1.42	4.60	2.10	2.00
PMOCRE	O-CRESOL	ug/L	2	2	39	5.1	1	7	14.3	1.60	1.33	7.20	3.80	3.00
PNFLUO	FLUORENE	ug/L	1	1	39	2.6	1	7	14.3	1.05	1.38	7.60	7.60	2.00
DIOXINS AND FURANS														
P98CDD	OCTACHLORODIBENZODIOXIN	ng/L	1	2	8	25.0	2	7	28.6	0.25	3.33	1.40	0.08	0.30
P94CDF	TETRACHLORODIBENZOFURAN	ng/L	2	1	8	12.5	1	7	14.3	0.09	2.20	0.10	0.10	0.10
PESTICIDES,HERBICIDES,PCBS														
P1BHCG	GAMMA-BHC(HEXACHLORCYCLHEXANE)	ug/L	2	29	40	72.5	6	7	85.7	0.02	2.28	0.09	0.01	0.01

TABLE 5-8 b - GLOBAL SUMMARY OF CONTAMINANTS IN PRIMARY EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
PESTICIDES,HERBICIDES,PCBS														
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	27	40	67.5	6	7	85.7	0.06	4.96	1.70	0.02	0.02
P3SILV	SILVEX	ug/L	3	9	40	22.5	4	7	57.1	0.03	2.19	1.40	0.05	0.05
P1PCBT	PCB, TOTAL	ug/L	2	7	40	17.5	2	7	28.6	0.03	3.06	0.45	0.05	0.04
P3245T	2,4,5-TRICLORPHENOXYACETIC ACID	ug/L	3	7	40	17.5	3	7	42.9	0.04	2.61	2.80	0.06	0.05
P1BHCB	BETA-BHC (HEXCHLORCYCLHEXANE)	ug/L	1	6	40	15.0	2	7	28.6	0.01	1.36	0.02	0.01	0.01
X2HCE	HEXACHLOROETHANE	ug/L	3	5	40	12.5	1	7	14.3	0.01	1.64	0.03	0.02	0.01
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	ug/L	1	2	40	5.0	1	7	14.3	0.01	1.58	0.05	0.03	0.01
P1END2	ENDOSULFAN II	ug/L	3	1	40	2.5	1	7	14.3	0.01	1.12	0.01	0.01	0.01
P1ENDS	ENDOSULFAN SULPHATE	ug/L	3	1	40	2.5	1	7	14.3	0.02	1.36	0.14	0.14	0.04
P1HEPT	HEPTACHLOR	ug/L	3	1	40	2.5	1	7	14.3	0.01	1.25	0.02	0.02	0.01
P1MIRX	MIREX	ug/L	1	1	40	2.5	1	7	14.3	0.01	1.39	0.04	0.04	0.01
P1PPDT	PP-DDT	ug/L	3 *	1	40	2.5	1	7	14.3	0.02	1.31	0.11	0.11	0.04
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/L	3	1	40	2.5	1	7	14.3	0.05	1.03	0.06	0.06	0.10
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	1	40	2.5	1	7	14.3	0.01	1.33	0.03	0.03	0.01
VOLATILES ORGANIC COMPOUNDS														
X1TETR	TETRACHLOROETHYLENE	ug/L	1	21	38	55.3	6	7	85.7	4.39	5.84	380.00	2.20	2.00
B2OXYL	O-XYLENE	ug/L	1	13	38	34.2	6	7	85.7	1.94	3.05	39.00	2.70	2.00
B2MPXY	M., AND P-XYLENES	ug/L	1	10	38	26.3	6	7	85.7	1.83	3.42	83.00	2.20	2.00
X1111T	1,1,1-TRICHLOROETHANE	ug/L	1	10	38	26.3	2	7	28.6	2.34	5.17	160.00	3.70	2.00
X1CTET	CARBON TETRACHLORIDE	ug/L	1	9	38	23.7	1	7	14.3	2.05	3.84	53.00	4.60	2.00
X1TRIC	TRICHLOROETHYLENE	ug/L	1	7	38	18.4	3	7	42.9	1.71	3.60	420.00	6.40	2.00
B2EBNZ	ETHYLBENZENE	ug/L	1	5	38	13.2	2	7	28.6	1.29	2.03	17.00	2.20	2.00
X1DCLE	1,1-DICHLOROETHENE	ug/L	1	3	38	7.9	1	7	14.3	1.43	3.44	110.00	70.00	2.00
B1OCTE	1-OCTENE	ug/L	1	1	38	2.6	1	7	14.3	1.58	1.36	10.00	10.00	3.00
B2STYR	STYRENE	ug/L	1	1	38	2.6	1	7	14.3	1.59	1.45	15.00	15.00	3.00

5.3.5 Summary of Contaminants in Lagoon Effluents

Table 5-9(a) presents the contaminants that were not detected in any effluent sample from either of the two lagoons sampled. In total, 133 contaminants were not detected, including 12 that were not confirmed. Also indicated in the Table are these 34 contaminants not detected in any sample at any WPCP.

Table 5-9(b) shows that in the lagoon effluents, only 7 organic compounds were detected, all from the pesticide/herbicide group. Only one herbicide (2,4-Dichlorophenoxy-acetic acid) was detected at both lagoons. Of the 10 metals detected, 9 were detected at both lagoons.

Only 3 organic compounds (2,4-Dichlorophenoxy-acetic acid, Methoxyclor and 1,2,4-Trichlorobenzene) were detected in more than 1 or 10 percent of the samples. Four metals (Al, Hg, Sr and Zn) were detected in more than 90 percent of the samples, while the other metals (Cd, Co, Mo, Ni, Cr, Cu) were detected in at least 17 percent of the samples.

5.3.6 Summary of Contaminants in Secondary Effluents

Table 5-10(a) presents the contaminants that were not detected in any effluent sample from any of the 28 secondary WPCPs. A total of 74 contaminants were never detected including 5 that were not confirmed. Also indicated in the Table are the 34 compounds never detected in any type of sample at any WPCP.

Data regarding contaminants detected in secondary WPCP effluents is presented in Table 5-10(b). Sixty-eight organic compounds, 14 metals and cyanide were detected in at least one secondary effluent sample. However, none of the base-neutral and acid extractable compounds or dioxins and furans were detected at more than 15 percent of the WPCP (4 plants).

Only 8 of the 23 compounds in the pesticide/herbicide group and 3 of the 17 volatile organic compounds were detected at more than 15 percent of the WPCPs. Metals were the most prevalent contaminants, with 11 metals detected at more than 50 percent of the WPCPs.

As noted, the most frequently detected contaminant group was metals, with 7 metals detected in greater than 50 percent of the secondary effluent samples. The most frequently detected base neutral and acid extractable compounds were found in less than 4 percent of samples; dioxin/furan compounds were found in less than 9 percent of samples, and volatile organic compounds were found in less than 10 percent of samples. Two pesticide/herbicide compounds (2,4-Dichlorophenoxyacetic and gamma-BHC) were detected in at least 70 percent of all the final effluent samples.

TABLE 5-9 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN LAGOON EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
AGUT	SILVER,UNFILT.TOTAL		
ASUT	ARSENIC,UNFILT.TOTAL		
BEUT	BERYLLIUM,UNFILT.TOTAL		
CCNFUR	CYANIDE-FREE,UNFILT.REAC.		
PBUT	LEAD,UNFILT.TOTAL		
SEUT	SELENIUM,UNFILT.TOTAL		
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
P2AMET	AMETRYNE	PMPCRE	P-CRESOL*
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DP	2,4-DICHLOROPHENOL		
PM24DT	2,4-DINITROTOLUENE		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM26DT	2,6-DINITROTOLUENE		
PM2NP	2-NITROPHENOL		
PM46DP	2-METHYL4,6-DINITROPHENOL		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PM4NP	4-NITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2EM	BIS(2-CHLORETHOXY)METHANE		
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER		
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER		
PMBBP	BUTYLBENZYLPHTHALATE		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDMP	DIMETHYL PHTHALATE		
PMDPE	DIPHENYL ETHER		
PMMCRE	M-CRESOL		
PMNITB	NITROBENZENE		
PMNND	N-NITROSO-DI-PHENYLAMINE		
PMNNP	N-NITROSO-DI-NPROPYLAMINE		
PMOCRE	O-CRESOL		
PMPCMC	P-CHLORO-M-CRESOL		
PMPHEN	PHENOL		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNACNY	ACENAPHTHYLENE		
PNANTH	ANTHRACENE		
PNBAA	BENZO(A)ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBBFA	BENZO(B)FLUORANTHENE		
PNBIPH	BIPHENYL		
PNBKF	BENZO(K)FLUORANTHENE		
PNCHRY	CHRYSENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNFLAN	FLUORANTHENE		
PNFLUO	FLUORENE		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PNNAPH	NAPHTHALENE		
PNPHEN	PHENANTHRENE		
PNPYR	PYRENE		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X30010	2-CHLOROPHENOL		
X3245	2,4,5-TRICHLOROPHENOL*		
X3246	2,4,6-TRICHLOROPHENOL		
X3PCPH	PENTACHLOROPHENOL		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P94CDF	TETRACHLORODIBENZOFURAN		
P95CDD	PENTACHLORODIBENZODIOXIN		
P95CDF	PENTACHLORODIBENZOFURAN		
P96CDD	HEXACHLORODIBENZODIOXIN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDD	HEPTACHLORODIBENZODIOXIN		
P97CDF	HEPTACHLORODIBENZOFURAN		
P98CDD	OCTACHLORODIBENZODIOXIN		
P98CDF	OCTACHLORODIBENZOFURAN		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-9 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN LAGOON EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	PESTICIDES, HERBICIDES, PCBS		
P0PCNB	PCNB	P0CAPN	CAPTAN*
P1ALDR	ALDRIN	P1END1	ENDOSULFAN I
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	P1END2	ENDOSULFAN II
P1BHCB	BETA-BHC (HEXCHLORCYCLHEXANE)	P1ENDR	ENDRIN
P1BHCD	DELTA-BHC(HEXCHLORCYCLHEXANE)	P1PPDT	PP-DDT
P1CHLA	ALPHA-CHLORDANE	P3245T	2,4,5-TRICLORPHENOXYACETIC ACID
P1CHLG	GAMMA-CHLORDANE	P3SILV	SILVEX
P1DIEL	DIELDRIN	X1HCBD	HEXACHLOROBUTADIENE*
P1ENDA	ELDRIN ALDEHYDE	X2HCE	HEXACHLOROETHANE
P1HEPE	HEPTACHLOREPOXID		
P1MIRX	MIREX		
P1OCHL	OXYCHLORDANE		
P1PCBT	PCB, TOTAL		
P1PMIR	MIREX PHOTO		
P1PPDD	PP-DDD		
P1PPDE	PP-DDE		
P1STRO	STROBANE*		
P1TOX	TOXAPHENE		
X2HCB	HEXACHLOROBENZENE		
	VOLATILES		
B1OCTE	1-OCTENE	X1ACRO	ACROLEIN
B1VBR	VINYL BROMIDE*	X1ACRY	ACRYLONITRILE*
B2BDCL	BROMODICHLOROBENZENE		
B2EBNZ	ETHYLBENZENE		
B2MPXY	M-, AND P-XYLENES		
B2OXYL	O-XYLENE		
B2STYR	STYRENE		
E1DIEE	DIETHYL ETHER		
L1HEX	HEXANOL		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X1111T	1,1,1-TRICHLOROETHANE		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X111CE	1,1-DICHLOROETHANE		
X112CE	1,2-DICHLOROETHANE		
X112CP	1,2-DICHLOROPROPANE		
X113DP	CIS-1,3-DICHLOROPROPENE		
X113DR	TRANS-1,3-DICHLOROPROPENE		
X1ACTO	ALPHA-CHLOROTOLUENE		
X1BDCM	BROMODICHLOROMETHANE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CDBM	CHLORODIBROMOMETHANE		
X1CDCE	CIS-1,2-DICHLOROETHYLENE		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1CHLO	CHLOROFORM		
X1CTET	CARBON TETRACHLORIDE		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1DCLE	1,1-DICHLOROETHENE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1TETR	TETRACHLOROETHYLENE		
X1TRIC	TRICHLOROETHYLENE		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X213CB	1,3-DICHLOROBENZENE		
X214CB	1,4-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-9 b - GLOBAL SUMMARY OF CONTAMINANTS IN LAGOON EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
CONVENTIONAL														
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	10	10	100.0	2	2	100.0	25.95	1.66	48.20	14.40	1.00
COD	CHEMICAL OXYGEN DEMAND	mg/L	0	10	10	100.0	2	2	100.0	70.64	1.47	110.00	44.00	5.00
DOC	DISSOLVED ORGANIC CARBON	mg/L	0	10	10	100.0	2	2	100.0	10.09	1.14	11.60	8.30	1.00
NNO2FR	NITRITE,FILT REACT.	mg/L	0	10	10	100.0	2	2	100.0	0.42	4.77	3.62	0.11	0.01
NNOTFR	NITRATES,TOTAL FILT REAC.	mg/L	0	10	10	100.0	2	2	100.0	1.65	3.25	6.15	0.40	0.05
NNTKUR	NITROGEN-TOT-KJEL,UNF.TOT	mg/L	0	10	10	100.0	2	2	100.0	10.85	1.64	43.00	8.30	0.01
PH	(-LOG(H+(CONCN))		0	10	10	100.0	2	2	100.0	7.92	1.03	8.38	7.57	1.00
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	6	6	100.0	1	1	100.0	0.26	1.18	0.31	0.20	0.01
RSP	RESIDUE, PARTICULATE	mg/L	0	10	10	100.0	2	2	100.0	29.12	1.50	51.40	17.30	1.00
RSPLOI	RESIDUE,PAR.LOSS ON IGNI.	mg/L	0	2	2	100.0	1	1	100.0	40.98	1.04	42.20	39.80	0.00
TURB	TURBIDITY	mg/L	0	5	5	100.0	1	1	100.0	25.76	1.20	30.00	19.40	0.25
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0	6	10	60.0	2	2	100.0	0.60	12.80	6.35	0.65	0.20
PHNOL	PHENOLICS (4AAP)	mg/L	0	2	10	20.0	1	2	50.0	0.07	1.91	0.34	0.13	0.10
METALS AND CYANIDE														
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	12	12	100.0	2	2	100.0	171.20	1.31	240.00	100.00	20.00
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	10	10	100.0	2	2	100.0	0.01	1.25	0.02	0.01	0.01
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	12	12	100.0	2	2	100.0	230.70	1.36	330.00	160.00	10.00
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	11	12	91.7	2	2	100.0	11.90	1.37	20.00	10.00	20.00
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	1	2	50.0	1	2	50.0	10.00	0.00	10.00	10.00	10.00
CDUT	CADMIUM,UNFILT.TOTAL	ug/L	0	3	12	25.0	2	2	100.0	1.80	1.49	4.00	3.00	3.00
COUT	COBALT,UNFILT.TOTAL	ug/L	0	3	12	25.0	2	2	100.0	6.30	1.41	10.00	10.00	10.00
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0	3	12	25.0	2	2	100.0	5.90	1.37	10.00	10.00	10.00
NIUT	NICKEL,UNFILT.TOTAL	ug/L	0	3	12	25.0	2	2	100.0	6.90	1.74	30.00	10.00	10.00
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	2	12	16.7	1	2	50.0	5.90	1.37	10.00	10.00	10.00
PESTICIDES,HERBICIDES,PCBS														
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	7	10	70.0	2	2	100.0	0.03	2.08	0.10	0.03	0.02
PIDMDT	METHOXYCHLOR	ug/L	1	4	10	40.0	1	2	50.0	0.07	3.77	0.70	0.10	0.05
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	2	10	20.0	1	2	50.0	0.01	2.11	0.04	0.02	0.01
PIBHCO	GAMMA-BHC(HEXACHLORCYCLHEXANE)	ug/L	2	1	10	10.0	1	2	50.0	0.01	1.25	0.01	0.01	0.01
PIENDS	ENDOSULFAN SULPHATE	ug/L	3	1	10	10.0	1	2	50.0	0.02	1.89	0.15	0.15	0.04
PIHEPT	HEPTACHLOR	ug/L	3	1	10	10.0	1	2	50.0	0.01	1.25	0.01	0.01	0.01
XIHCCP	HEXACHLOROCYCLOPENTADIENE	ug/L	3	1	10	10.0	1	2	50.0	0.06	1.35	0.13	0.13	0.10

TABLE 5-10 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN SECONDARY EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
BEUT	BERYLLIUM,UNFILT.TOTAL		
	BASE NEUTRAL & ACID EXTRACTABLE COMPOUNDS		
P2AMET	AMETRYNE	PMPCRE	P-CRESOL*
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDPE	DIPHENYL ETHER		
PMNND	N-NITROSO-DI-PHENYLAMINE		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNACNY	ACENAPHTHYLENE		
PNANTH	ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBBFA	BENZO(B)FLUORANTHENE		
PNBIPH	BIPHENYL		
PNCHRY	CHRYSENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNFLAN	FLUORANTHENE		
PNFLUO	FLUORENE		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X3245	2,4,5-TRICHLOROPHENOL*		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P95CDD	PENTACHLORODIBENZODIOXIN		
P95CDF	PENTACHLORODIBENZOFURAN		
P96CDD	HEXACHLORODIBENZODIOXIN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDF	HEPTACHLORODIBENZOFURAN		
	PESTICIDES, HERBICIDES, PCBS		
POPCNB	PCNB	POCAPN	CAPTAN*
P1ALDR	ALDRIN	X1HCBD	HEXACHLOROBUTADIENE*
P1BHCD	DELTA-BHC(HEXCHLORCYCLHEXANE)		
P1ENDA	ELDRIN ALDEHYDE		
P1HEPE	HEPTACHLOREPOXIDE		
P1OCHL	OXYCHLORDANE		
P1PMIR	MIREX PHOTO		
P1STRO	STROBANE*		
X2HCB	HEXACHLOROBENZENE		
	VOLATILES		
B1OCTE	1-OCTENE	X1ACRO	ACROLEIN
B1VBR	VINYL BROMIDE*	X1ACRY	ACRYLONITRILE*
E1DIEE	DIETHYL ETHER		
L1HEX	HEXANOL		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X112CP	1,2-DICHLOROPROPANE		
X113DP	CIS-1,3-DICHLOROPROPENE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1CTET	CARBON TETRACHLORIDE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X213CB	1,3-DICHLOROBENZENE		
X214CB	1,4-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-10 b - GLOBAL SUMMARY OF CONTAMINANTS IN SECONDARY EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
CONVENTIONAL														
DOC	DISSOLVED ORGANIC CARBON	mg/L	0	220	220	100.0	28	28	100.0	8.09	1.60	297.00	2.70	1.00
NNTKUR	NITROGEN-TOT-KJEL,UNF.TOT	mg/L	0	222	222	100.0	28	28	100.0	7.97	2.71	32.10	0.80	0.01
PH	(-LOG(H+(CONCN))		0	224	224	100.0	28	28	100.0	7.10	1.05	8.18	6.38	1.00
TURB	TURBIDITY	mg/L	0	153	153	100.0	22	22	100.0	7.41	2.90	200.00	0.46	0.25
RSP	RESIDUE, PARTICULATE	mg/L	0	219	220	99.6	28	28	100.0	10.12	2.00	242.00	3.50	1.00
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	211	213	99.1	28	28	100.0	21.22	2.07	110.00	3.50	1.00
COD	CHEMICAL OXYGEN DEMAND	mg/L	0	211	213	99.1	28	28	100.0	52.80	1.83	226.00	12.00	5.00
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	206	211	97.6	24	24	100.0	0.68	1.97	5.45	0.19	0.01
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0	204	223	91.5	28	28	100.0	3.90	6.98	27.70	0.05	0.20
NNO2FR	NITRITE,FILT. REACT.	mg/L	0	194	220	88.2	27	28	96.4	0.22	5.95	3.30	0.03	0.01
NNOTFR	NITRATES,TOTAL FILT.REAC.	mg/L	0	186	224	83.0	27	28	96.4	2.33	7.75	28.40	0.25	0.05
RSPLOI	RESIDUE,PAR.LOSS ON IGNI.	mg/L	0	58	77	75.3	14	15	93.3	7.47	2.71	162.00	5.20	0.00
PHNOL	PHENOLICS (4AAP)	mg/L	0	33	225	14.7	15	28	53.6	0.07	1.86	0.68	0.10	0.10
METALS AND CYANIDE														
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	267	267	100.0	28	28	100.0	340.90	2.14	4500.00	80.00	10.00
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	262	267	98.1	28	28	100.0	53.30	2.48	1400.00	10.00	20.00
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	220	233	94.4	28	28	100.0	0.03	2.62	0.36	0.01	0.01
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	196	264	74.2	27	28	96.4	101.70	3.72	5800.00	40.00	20.00
NIUT	NICKEL,UNFILT.TOTAL	ug/L	0	171	267	64.0	24	28	85.7	22.10	3.60	900.00	10.00	10.00
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	30	47	63.8	21	27	77.8	13.10	2.56	190.00	10.00	10.00
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	137	267	51.3	25	28	89.3	9.00	2.00	140.00	10.00	10.00
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0	75	267	28.1	19	28	67.9	6.60	1.56	20.00	10.00	10.00
COUT	COBALT,UNFILT.TOTAL	ug/L	0	65	266	24.4	23	28	82.1	6.40	1.54	20.00	10.00	10.00
CDUT	CADMIUM,UNFILT.TOTAL	ug/L	0	65	267	24.3	20	28	71.4	2.10	2.07	14.00	3.00	3.00
CCNFUR	CYANIDE-FREE,UNFILT.REAC.	ug/L	0	42	222	18.9	13	28	46.4	1.30	3.68	43.00	6.00	1.00
PBUT	LEAD,UNFILT.TOTAL	ug/L	0	25	267	9.4	17	28	60.7	16.50	1.48	91.00	20.00	30.00
AGUT	SILVER,UNFILT.TOTAL	ug/L	0	15	267	5.6	9	28	32.1	6.90	1.84	1250.00	10.00	10.00
ASUT	ARSENIC,UNFILT.TOTAL	ug/L	0	3	252	1.2	1	28	3.6	16.70	1.67	60.00	60.00	30.00
SEUT	SELENIUM,UNFILT.TOTAL	ug/L	0	3	252	1.2	1	28	3.6	17.10	1.89	80.00	80.00	30.00
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PMMCRE	M-CRESOL	ug/L	1	7	227	3.1	4	28	14.3	1.70	1.70	30.50	4.30	3.00
PMPHEN	PHENOL	ug/L	2	4	227	1.8	3	28	10.7	1.65	1.59	17.30	7.50	3.00
PMNITB	NITROBENZENE	ug/L	1	4	228	1.8	4	28	14.3	1.09	1.54	5.70	4.50	2.00
PMBBP	BUTYLBENZYLPHTHALATE	ug/L	1	3	228	1.3	2	28	7.1	1.09	1.59	25.00	3.80	2.00
X3PCPH	PENTACHLOROPHENOL	ug/L	1	3	227	1.3	2	28	7.1	2.71	1.56	58.70	6.80	5.00
PMPCMC	P-CHLORO-M-CRESOL	ug/L	1	2	227	0.9	2	28	7.1	2.68	1.50	15.20	5.30	5.00
PM24DP	2,4-DICHLOROPHENOL	ug/L	1	1	227	0.4	1	28	3.6	2.68	1.52	28.80	28.80	5.00
PM24DT	2,4-DINITROTOLUENE	ug/L	1	1	228	0.4	1	28	3.6	1.61	1.53	23.90	23.90	3.00
PM26DT	2,6-DINITROTOLUENE	ug/L	1	1	228	0.4	1	28	3.6	1.61	1.53	26.80	26.80	3.00
PM2NP	2-NITROPHENOL	ug/L	1	1	227	0.4	1	28	3.6	2.68	1.52	28.50	28.50	5.00
PM46DP	2-METHYL4,6-DINITROPHENOL	ug/L	2	1	227	0.4	1	28	3.6	2.70	1.60	143.70	143.70	5.00
PM4NP	4-NITROPHENOL	ug/L	2	1	227	0.4	1	28	3.6	2.67	1.50	20.80	20.80	5.00
PMB2EM	BIS(2-CHLOROETHOXY)METHANE	ug/L	1	1	228	0.4	1	28	3.6	1.08	1.56	32.80	32.80	2.00
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER	ug/L	2	1	228	0.4	1	28	3.6	1.61	1.54	30.60	30.60	3.00
PMDMP	DIMETHYL PHTHALATE	ug/L	1	1	228	0.4	1	28	3.6	1.07	1.48	2.60	2.60	2.00
PMNNP	N-NITROSO-DI-NPROPYLAMINE	ug/L	1	1	228	0.4	1	28	3.6	1.08	1.58	43.60	43.60	2.00
PMOCRE	O-CRESOL	ug/L	2	1	227	0.4	1	28	3.6	1.60	1.49	7.50	7.50	3.00
PNBAA	BENZO(A)ANTHRACENE	ug/L	1	1	228	0.4	1	28	3.6	1.08	1.56	29.40	29.40	2.00

TABLE 5-10 b - GLOBAL SUMMARY OF CONTAMINANTS IN SECONDARY EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PNBKF	BENZO(K)FLUORANTHENE	ug/L	1	1	228	0.4	1	28	3.6	1.07	1.53	14.60	14.60	2.00
PNNAPH	NAPHTHALENE	ug/L	1	1	228	0.4	1	28	3.6	1.06	1.48	2.40	2.40	2.00
PNPHEN	PHENANTHRENE	ug/L	1	1	228	0.4	1	28	3.6	1.07	1.53	17.80	17.80	2.00
PNPYR	PYRENE	ug/L	1	1	228	0.4	1	28	3.6	1.61	1.54	29.40	29.40	3.00
X3001O	2-CHLOROPHENOL	ug/L	0	1	227	0.4	1	28	3.6	2.66	1.47	5.10	5.10	5.00
X3246	2,4,6-TRICHLOROPHENOL	ug/L	1	1	227	0.4	1	28	3.6	2.66	1.48	9.20	9.20	5.00
DIOXINS AND FURANS														
P98CDD	OCTACHLORODIBENZODIOXIN	ng/L	1	4	44	9.1	4	28	14.3	0.31	3.43	11.00	0.10	0.30
P97CDD	HEPTACHLORODIBENZODIOXIN	ng/L	1	2	44	4.6	2	28	7.1	0.38	3.74	4.30	1.40	0.10
P98CDF	OCTACHLORODIBENZOFURAN	ng/L	1	2	44	4.6	2	28	7.1	0.28	2.90	0.50	0.50	0.20
P94CDF	TETRACHLORODIBENZOFURAN	ng/L	2	1	44	2.3	1	28	3.6	0.15	3.90	0.33	0.33	0.10
PESTICIDES,HERBICIDES,PCBS														
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	177	227	78.0	28	28	100.0	0.08	4.71	34.00	0.02	0.02
P1BHCG	GAMMA-BHC(HEXCHLORCYCLHEXANE)	ug/L	2	157	227	69.2	27	28	96.4	0.02	2.48	0.79	0.01	0.01
X2124	1,2,4-TRICHLOROBENZENE	ug/L	3	36	227	15.9	9	28	32.1	0.01	2.44	0.36	0.02	0.01
P3245T	2,4,5-TRICLORPHENOXYACETIC ACID	ug/L	3	25	227	11.0	12	28	42.9	0.03	2.27	2.30	0.05	0.05
P3SILV	SILVEX	ug/L	3	23	227	10.1	14	28	50.0	0.03	1.83	2.90	0.05	0.05
P1BHCB	BETA BHC (HEXCHLORCYCLHEXANE)	ug/L	1	9	227	4.0	6	28	21.4	0.01	1.38	0.07	0.01	0.01
P1PCBT	PCB, TOTAL	ug/L	2	9	227	4.0	8	28	28.6	0.02	1.40	0.19	0.04	0.04
P1PPDE	PP-DDE	ug/L	1	7	227	3.1	5	28	17.9	0.01	1.28	0.04	0.01	0.01
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	ug/L	1	5	227	2.2	4	28	14.3	0.01	1.24	0.03	0.01	0.01
P1CHLA	ALPHA CHLORDANE	ug/L	1	5	227	2.2	4	28	14.3	0.01	1.31	0.06	0.01	0.01
P1CHLG	GAMMA CHLORDANE	ug/L	1	5	227	2.2	4	28	14.3	0.01	1.36	0.08	0.02	0.01
X2HCE	HEXACHLOROETHANE	ug/L	3	5	227	2.2	4	28	14.3	0.01	1.23	0.05	0.01	0.01
P1ENDS	ENDOSULFAN SULPHATE	ug/L	3	3	227	1.3	2	28	7.1	0.02	1.22	0.17	0.06	0.04
P1TOX	TOXAPHENE	ug/L	0	3	227	1.3	2	28	7.1	0.02	1.13	0.04	0.04	0.04
P1DIEL	DIELDRIN	ug/L	2	2	227	0.9	1	28	3.6	0.01	1.10	0.01	0.01	0.01
P1END2	ENDOSULFAN II	ug/L	3	2	227	0.9	1	28	3.6	0.01	1.19	0.04	0.02	0.01
P1HEPT	HEPTACHLOR	ug/L	3	2	227	0.9	2	28	7.1	0.01	1.16	0.02	0.02	0.01
P1PPDD	PP-DDD	ug/L	1	2	227	0.9	2	28	7.1	0.01	1.10	0.01	0.01	0.01
P1PPDT	PP-DDT	ug/L	3	2	227	0.9	2	28	7.1	0.02	1.14	0.07	0.06	0.04
P1END1	ENDOSULFAN I	ug/L	3	1	227	0.4	1	28	3.6	0.01	1.12	0.02	0.02	0.01
P1ENDR	ENDRIN	ug/L	3	1	227	0.4	1	28	3.6	0.01	1.14	0.03	0.03	0.01
P1MIRX	MIREX	ug/L	1	1	227	0.4	1	28	3.6	0.01	1.08	0.01	0.01	0.01
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/L	3	1	227	0.4	1	28	3.6	0.05	1.20	0.26	0.26	0.10
VOLATILES														
X1111T	1,1,1-TRICHLOROETHANE	ug/L	1	18	224	8.0	8	28	28.6	1.18	1.86	27.00	2.10	2.00
X1TETR	TETRACHLOROETHYLENE	ug/L	1	18	224	8.0	9	28	32.1	1.18	1.93	84.00	2.00	2.00
X1TRIC	TRICHLOROETHYLENE	ug/L	1	17	224	7.6	6	28	21.4	1.12	1.55	14.00	2.00	2.00
B2MPXY	M-, AND P XYLENES	ug/L	1	5	224	2.2	3	28	10.7	1.05	1.45	27.00	2.40	2.00
B2OXYL	O XYLENE	ug/L	1	5	224	2.2	4	28	14.3	1.05	1.38	17.00	2.70	2.00
X112CE	1,2-DICHLOROETHANE	ug/L	1	4	224	1.8	3	28	10.7	1.03	1.30	10.00	2.00	2.00
X1CDBM	CHLORODIBROMOMETHANE	ug/L	1	4	224	1.8	2	28	7.1	1.02	1.13	2.60	2.30	2.00

TABLE 5-10 b - GLOBAL SUMMARY OF CONTAMINANTS IN SECONDARY EFFLUENTS

CONTAMINANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
VOLATILES														
B2BDCL	BROMODICHLOROBENZENE	ug/L	1	3	224	1.3	2	28	7.1	4.93	1.21	10.00	10.00	10.00
B2EBNZ	ETHYL BENZENE	ug/L	1	3	224	1.3	2	28	7.1	1.02	1.21	12.00	2.70	2.00
X111CE	1,1-DICHLOROETHANE	ug/L	1	3	224	1.3	3	28	10.7	1.01	1.10	2.30	2.20	2.00
X1CDCE	CIS-1,2-DICHLOROETHYLENE	ug/L	1	2	224	0.9	2	28	7.1	1.01	1.11	4.10	2.20	2.00
B2STYR	STYRENE	ug/L	1	1	224	0.5	1	28	3.6	1.51	1.16	13.00	13.00	3.00
X113DR	TRANS-1,3 DICHLOROPROPENE	ug/L	1	1	224	0.5	1	28	3.6	1.00	1.06	2.40	2.40	2.00
X1ACTO	ALPHA-CHLOROTOLUENE	ug/L	1	1	224	0.5	1	28	3.6	1.50	1.05	3.00	3.00	3.00
X1DCFM	DICHLORODIFLUOROMETHANE	ug/L	2	1	224	0.5	1	28	3.6	10.07	1.12	53.00	53.00	20.00
X1DCTE	1,1-DICHLOROETHENE	ug/L	1	1	224	0.5	1	28	3.6	1.01	1.18	2.20	2.20	2.00
X2CBEN	CHLOROBENZENE	ug/L	1	1	224	0.5	1	28	3.6	1.00	1.05	2.10	2.10	2.00

5.3.7 Summary of Contaminants in Tertiary Effluents

Only the Guelph WPCP of all the study plants provided tertiary treatment. The 128 contaminants that were not detected in the Guelph tertiary effluent including 12 that were not confirmed, are presented in Table 5-11(a). Also indicated are the 34 contaminants that were not detected in any sample type at any WPCP.

Thirty-one organic contaminants, 12 metals and cyanide were detected in at least one sample. Table 5-11(b) presents the listing of contaminants fround in the Guelph tertiary effluent. Metals were the most frequently detected contaminant, with 6 metals (Al, Cr, Cu, Hg, Sr and Zn) detected in more than 75 percent of samples. Only 2 pesticide and herbicide compounds (2,4-Dichlorophenoxyacetic acid and gamma-BHC) were present in more than 50 percent of the samples. The most frequently detected volatile organic compound was detected in only 50 percent of the samples. The most frequently detected base neutral and acid extractable compound was detected in only 30 percent of samples, and there were no dioxin/furan compounds detected in the Guelph tertiary effluent.

5.3.8 Summary of Contaminants in Raw Sludges

Table 5-12(a) presents a list of the 85 contaminants that were not detected in any of the raw sludge from any WPCP, including 6 compounds that were not confirmed. Also indicated are the 34 compounds that were not detected in any sample type at any WPCP.

Table 5-12(b) presents the summary of detected contaminants for all raw sludges. A total of 59 organic compounds, 15 metals and cyanide were detected in any sample. The most prevalent organic compounds were the pesticides and herbicides, with 11 compounds detected in at least 40 percent of the plants. Only 2 of the base neutral and acid extractable compounds, 4 of the volatile compounds and 1 dioxin compound were detected at more than 20 percent of the plants. All of the metals except beryllium were detected at greater than 64 percent of the plants. Cyanide was detected at 10 percent of the plants.

The most frequently detected contaminants were metals, with 12 metals detected in at least 80 percent of the samples, including 5 (Al, Hg, Sr, Zn, Cu) that were detected in all of the samples. Only 1 of the base neutral and acid extractable compounds and 1 volatile compound were detected in more than 30 percent of the samples, and only one dioxin (Octachlorodibenzodioxin) was detected in greater than 12

TABLE 5-11 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN TERTIARY EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
BEUT	BERYLLIUM,UNFILT.TOTAL		
CCNFUR	CYANIDE-FREE,UNFILT.REAC.		
COUT	COBALT,UNFILT.TOTAL		
MOUT	MOLYBDENUM,UNFILT.TOTAL		
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
P2AMET	AMETRYNE	PMPCRE	P-CRESOL*
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DP	2,4-DICHLOROPHENOL		
PM24DT	2,4-DINITROTOLUENE		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM26DT	2,6-DINITROTOLUENE		
PM2NP	2-NITROPHENOL		
PM46DP	2-METHYL4,6-DINITROPHENOL		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PM4NP	4-NITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2EM	BIS(2-CHLORETHOXY)METHANE		
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER		
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER		
PMBBP	BUTYLBENZYLPHTHALATE		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDMP	DIMETHYL PHTHALATE		
PMNITB	NITROBENZENE		
PMNND	N-NITROSO-DI-PHENYLAMINE		
PMNNP	N-NITROSO-DI-NPROPYLAMINE		
PMOCRE	O-CRESOL		
PMPCMC	P-CHLORO-M-CRESOL		
PMPHEN	PHENOL		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNACNY	ACENAPHTHYLENE		
PNANTH	ANTHRACENE		
PNBAA	BENZO(A)ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBBFA	BENZO(B)FLUORANTHENE		
PNBIPH	BIPHENYL		
PNBKF	BENZO(K)FLUORANTHENE		
PNCHRY	CHRYSENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNFLAN	FLUORANTHENE		
PNFLUO	FLUORENE		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PNNAPH	NAPHTHALENE		
PNPHEN	PHENANTHRENE		
PNPYR	PYRENE		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X30010	2-CHLOROPHENOL		
X3245	2,4,5-TRICHLOROPHENOL*		
X3246	2,4,6-TRICHLOROPHENOL		
X3PCPH	PENTACHLOROPHENOL		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P94CDF	TETRACHLORODIBENZOFURAN		
P95CDD	PENTACHLORODIBENZODIOXIN		
P95CDF	PENTACHLORODIBENZOFURAN		
P96CDD	HEXACHLORODIBENZODIOXIN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDP	HEPTACHLORODIBENZOFURAN		
P98CDF	OCTACHLORODIBENZOFURAN		
	PESTICIDES, HERBICIDES, PCBS		
P0PCNB	PCNB	P0CAPN	CAPTAN*
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	P1END2	ENDOSULFAN II
P1BHCG	GAMMA-BHC(HEXCHLORCYCLHEXANE)	P1ENDR	ENDRIN
P1DMDT	METHOXYCHLOR	P1ENDS	ENDOSULFAN SULPHATE
P1MIRX	MIREX	P1HEPT	HEPTACHLOR

* - NOT DECTECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-11 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN TERTIARY EFFLUENTS

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	PESTICIDES, HERBICIDES, PCBS		
P1OCHL	OXYCHLORDANE	P324D	2,4-DICHLOROPHENOXYACETIC ACID
P1PMIR	MIREX PHOTO	X1HCB D	HEXACHLOROBUTADIENE*
P1STRO	STROBANE*	X1HCCP	HEXACHLOROCYCLOPENTADIENE
P1TOX	TOXAPHE	X2124	1,2,4-TRICHLOROBENZENE
X2HCB	HEXACHLOROBENZENE		
	VOLATILES		
B1OCTE	1-OCTENE	X1ACRO	ACROLEIN
B1VBR	VINYL BROMIDE*	X1ACRY	ACRYLONITRILE*
B2BDCL	BROMODICHLOROBENZENE		
B2EBNZ	ETHYLBENZENE		
B2MPXY	M-, AND P-XYLENES		
B2OXYL	O-XYLENE		
B2STYR	STYRENE		
E1DIEE	DIETHYL ETHER		
L1HEX	HEXANOL		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X1111T	1,1,1-TRICHLOROETHANE		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X111CE	1,1-DICHLOROETHANE		
X112CE	1,2-DICHLOROETHANE		
X112CP	1,2-DICHLOROPROPANE		
X113DP	CIS-1,3-DICHLOROPROPENE		
X113DR	TRANS-1,3-DICHLOROPROPENE		
X1ACTO	ALPHA-CHLOROTOLUENE		
X1BDCM	BROMODICHLOROMETHANE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CDBM	CHLORODIBROMOMETHANE		
X1CDCE	CIS-1,2-DICHLOROETHYLENE		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1CHLO	CHLOROFORM		
X1CTET	CARBON TETRACHLORIDE		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1DCLE	1,1-DICHLOROETHENE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1TETR	TETRACHLOROETHYLENE		
X1TRIC	TRICHLOROETHYLENE		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X213CB	1,3-DICHLOROBENZENE		
X214CB	1,4-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DECTECTED IN ANY STREAM TYPE AT ANY PLANT

<u>TABLE 5-11 b - GLOBAL SUMMARY OF CONTAMINANTS IN TERTIARY EFFLUENTS</u>

CONTAM-INANT	CONTAMINANT NAME	UNITS	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL	DET. LIMIT (DL)
CONVENTIONAL														
BOD5	BOD, 5 DAY -TOTAL DEMAND	mg/L	0	9	9	100.0	1	1	100.0	24.64	1.48	56.40	16.00	0.00
COD	CHEMICAL OXYOEN DEMAND	mg/L	0	9	9	100.0	1	1	100.0	99.25	1.80	282.00	46.00	0.00
DOC	DISSOLVED OROANIC CARBON	mg/L	0	9	9	100.0	1	1	100.0	8.74	1.19	10.90	7.00	0.00
NNHTFR	AMMONIUM,TOTAL FILT.REAC.	mg/L	0	9	9	100.0	1	1	100.0	18.24	1.08	20.80	16.60	0.00
NNTKUR	NITROGEN-TOT-KJEL,UNF.TOT	mg/L	0	9	9	100.0	1	1	100.0	23.22	1.17	34.00	19.80	0.00
PH	(-LOG(H+(CONCN))		0	9	9	100.0	1	1	100.0	7.10	1.04	7.49	6.82	0.00
PPUT	PHOSPHORUS,UNFILT.TOTAL	mg/L	0	10	10	100.0	1	1	100.0	1.56	1.92	5.93	0.78	0.50
RSP	RESIDUE, PARTICULATE	mg/L	0	8	8	100.0	1	1	100.0	32.21	1.74	71.80	17.10	0.00
TURB	TURBIDITY	mg/L	0	5	5	100.0	1	1	100.0	10.99	1.39	18.30	8.20	0.00
NNO2FR	NITRITE,FILT. REACT.	mg/L	0	8	9	88.9	1	1	100.0	0.05	3.45	0.15	0.03	0.00
NNOTFR	NITRATES,TOTAL FILT.REAC.	mg/L	0	5	9	55.6	1	1	100.0	0.14	4.23	0.50	0.40	0.00
METALS AND CYANIDE														
ALUT	ALUMINUM,UNFILT.TOTAL	ug/L	0	11	11	100.0	1	1	100.0	1252.00	1.88	2900.00	560.00	500.00
CRUT	CHROMIUM,UNFILT.TOTAL	ug/L	0	11	11	100.0	1	1	100.0	68.80	1.84	270.00	30.00	500.00
CUUT	COPPER,UNFILT.TOTAL	ug/L	0	2	2	100.0	1	1	100.0	54.80	3.03	120.00	25.00	500.00
HGUT	MERCURY,UNFILT.TOTAL	ug/L	0	9	9	100.0	1	1	100.0	0.17	1.73	0.39	0.07	0.01
SRUT	STRONTIUM,UNFILT.TOTAL	ug/L	0	11	11	100.0	1	1	100.0	1170.70	1.11	1400.00	990.00	500.00
ZNUT	ZINC,UNFILT.TOTAL	ug/L	0	11	11	100.0	1	1	100.0	959.60	1.30	1600.00	650.00	500.00
CCNFUR	CYANIDE-FREE,UNFILT.REAC.	ug/L	0	7	9	77.8	1	1	100.0	14.60	4.19	70.00	7.00	3.00
CDUT	CADMIUM,UNFILT.TOTAL	ug/L	0	3	11	27.3	1	1	100.0	6.30	1.74	20.00	11.00	500.00
COUT	COBALT,UNFILT.TOTAL	ug/L	0	3	11	27.3	1	1	100.0	9.00	2.75	70.00	10.00	1000.00
PBUT	LEAD,UNFILT.TOTAL	ug/L	0	2	11	18.2	1	1	100.0	55.90	1.50	130.00	110.00	500.00
AGUT	SILVER,UNFILT.TOTAL	ug/L	0	1	11	9.1	1	1	100.0	6.60	2.02	10.00	10.00	50.00
MOUT	MOLYBDENUM,UNFILT.TOTAL	ug/L	0	1	11	9.1	1	1	100.0	11.30	1.52	40.00	40.00	250.00
NIUT	NICKEL,UNFILT.TOTAL	ug/L	0	1	11	9.1	1	1	100.0	25.80	1.12	36.00	36.00	3000.00
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS														
PM24MP	2,4-DIMETHYLPHENOL	ug/L	2	3	10	30.0	1	1	100.0	3.40	1.57	7.50	5.60	500.00
PMPHEN	PHENOL	ug/L	2	3	10	30.0	1	1	100.0	1.99	1.59	4.40	3.40	300.00
PM24DP	2,4-DICHLOROPHENOL	ug/L	1	1	10	10.0	1	1	100.0	2.87	1.55	9.90	9.90	500.00
PM24DT	2,4-DINITROTOLUENE	ug/L	1	1	10	10.0	1	1	100.0	1.70	1.49	5.30	5.30	300.00
PM26DT	2,6-DINITROTOLUENE	ug/L	1	1	10	10.0	1	1	100.0	1.77	1.68	7.70	7.70	300.00
PM2NP	2-NITROPHENOL	ug/L	1	1	10	10.0	1	1	100.0	2.73	1.32	6.00	6.00	500.00
PM46DP	2-METHYL4,6-DINITROPHENOL	ug/L	2	1	10	10.0	1	1	100.0	3.18	2.14	27.60	27.60	500.00
PMB2EM	BIS(2-CHLORETHOXY)METHANE	ug/L	1	1	10	10.0	1	1	100.0	1.31	2.34	14.80	14.80	200.00
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER	ug/L	2	1	10	10.0	1	1	100.0	1.86	1.97	12.70	12.70	300.00
PMBBP	BUTYLBENZYLPHTHALATE	ug/L	1	1	10	10.0	1	1	100.0	1.13	1.46	3.30	3.30	200.00
PMNNP	N-NITROSO-DI-NPROPYLAMINE	ug/L	1	1	10	10.0	1	1	100.0	1.34	2.55	19.20	19.20	200.00
PNBAA	BENZO(A)ANTHRACENE	ug/L	1	1	10	10.0	1	1	100.0	1.29	2.23	12.60	12.60	200.00
PNBKF	BENZO(K)FLUORANTHENE	ug/L	1	1	10	10.0	1	1	100.0	1.16	1.62	4.60	4.60	200.00
PNPYR	PYRENE	ug/L	1	1	10	10.0	1	1	100.0	1.85	1.93	12.00	12.00	300.00
X3PCPH	PENTACHLOROPHENOL	ug/L	1	1	10	10.0	1	1	100.0	3.10	1.97	21.50	21.50	500.00

TABLE 5-8 b - GLOBAL SUMMARY OF CONTAMINANTS IN TERTIARY EFFLUENTS

CONTAM-INANT	CONTAMINANT NAME	UNITS	QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. >DL	DET. LIMIT (DL)
PESTICIDES,HERBICIDES,PCBS														
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/L	3	9	10	90.0	1	1	100.0	0.12	2.56	0.67	0.05	0.40
P1BHCO	GAMMA-BHC(HEXCHLORCYCLHEXANE)	ug/L	2	8	10	80.0	1	1	100.0	0.04	3.37	0.75	0.02	0.20
P1BHCB	BETA-BHC (HEXCHLORCYCLHEXANE)	ug/L	1	3	10	30.0	1	1	100.0	0.02	3.03	0.17	0.05	0.20
P1DMDT	METHOXYCHLOR	ug/L	1	2	10	20.0	1	1	100.0	0.07	1.90	0.26	0.20	1.00
P3SILV	SILVEX	ug/L	3	2	10	20.0	1	1	100.0	0.06	1.34	0.10	0.10	1.00
P1ENDR	ENDRIN	ug/L	3	1	10	10.0	1	1	100.0	0.01	1.66	0.05	0.05	0.20
P1PCBT	PCB, TOTAL	ug/L	2	1	10	10.0	1	1	100.0	0.05	1.55	0.16	0.16	0.80
X2124	1,2,4-TRICHLOROBENZENE	ug/l	3	1	10	10.0	1	1	100.0	0.01	1.66	0.05	0.05	0.20
VOLATILES														
X1TETR	TETRACHLOROETHYLENE	ug/L	1	5	10	50.0	1	1	100.0	3.50	4.30	50.00	5.80	40.00
X111TT	1,1,1-TRICHLOROETHANE	ug/L	1	4	10	40.0	1	1	100.0	2.30	4.02	75.00	2.70	40.00
X1DCLE	1,1-DICHLOROETHENE	ug/L	1	2	10	20.0	1	1	100.0	1.56	2.61	14.00	6.10	40.00
B1DIEE	DIETHYL ETHER	ug/L	1	1	10	10.0	1	1	100.0	1.28	2.19	12.00	12.00	40.00
X111CE	1,1-DICHLOROETHANE	ug/L	1	1	10	10.0	1	1	100.0	1.23	1.91	7.80	7.80	40.00
X112CE	1,2-DICHLOROETHANE	ug/L	1	1	10	10.0	1	1	100.0	1.10	1.37	2.70	2.70	40.00
X1CDCE	CIS-1,2-DICHLOROETHYLENE	ug/L	1	1	10	10.0	1	1	100.0	1.17	1.66	5.00	5.00	40.00
X1TRIC	TRICHLOROETHYLENE	ug/L	1	1	10	10.0	1	1	100.0	1.26	2.05	9.70	9.70	40.00

TABLE 5-12 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN RAW SLUDGES

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
		PMPCRE	P-CRESOL*
P2AMET	AMETRYNE		
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DP	2,4-DICHLOROPHENOL		
PM24DT	2,4-DINITROTOLUENE		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM26DT	2,6-DINITROTOLUENE		
PM2NP	2-NITROPHENOL		
PM46DP	2-METHYL4,6-DINITROPHENOL		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PM4NP	4-NITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2EM	BIS(2-CHLORETHOXY)METHANE		
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDMP	DIMETHYL PHTHALATE		
PMNNP	N-NITROSO-DI-NPROPYLAMINE		
PMOCRE	O-CRESOL		
PMPCMC	P-CHLORO-M-CRESOL		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNBAA	BENZO(A)ANTHRACENE		
PNBAP	BENZO(A)PYRENE		
PNBIPH	BIPHENYL		
PNBKF	BENZO(K)FLUORANTHENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNFLUO	FLUORENE		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X30010	2-CHLOROPHENOL		
X3245	2,4,5-TRICHLOROPHENOL*		
X3246	2,4,6-TRICHLOROPHENOL		
	PENTACHLOROPHENOL		
	DIOXINS AND FURAN		
X3PCPH	TETRACHLORODIBENZODIOXIN*		
P94CDD	PENTACHLORODIBENZODIOXIN		
P95CDD	HEXACHLORODIBENZODIOXIN		
P96CDD			
	PESTICIDES, HERBICIDES, PCBS		
	PCNB		
POPCNB	ELDRIN ALDEHYDE	POCAPN	CAPTAN*
P1ENDA	MIREX PHOTO	X1HCBD	HEXACHLOROBUTADIENE*
P1PMIR	STROBANE*	X2HCE	HEXACHLOROETHANE
P1STRO	TOXAPHENE		
P1TOX			
	VOLATILES		
	1-OCTENE		
B1OCTE	VINYL BROMIDE*	X1ACRO	ACROLEIN
B1VBR	BROMODICHLOROBENZENE	X1ACRY	ACRYLONITRILE*
B2BDCL	DIETHYL ETHER		
E1DIEE	HEXANOL		
L1HEX	2-CHLOROETHYLVINYLETHER*		
PM2CEE	1,1,1-TRICHLOROETHANE		
X1111T	1,1,2,2-TETRACHLOROETHANE*		
X11122	1,1,2-TRICHLOROETHANE*		
X1112T	1,1-DICHLOROETHANE		
X111CE	1,2-DICHLOROETHANE		
X112CE	1,2-DICHLOROPROPANE		
X112CP	CIS-1,3-DICHLOROPROPENE		
X113DP	TRANS-1,3-DICHLOROPROPENE		
X113DR	ALPHA-CHLOROTOLUENE		
X1ACTO	BROMOETHANE*		
X1BETH	BROMOFORM*		
X1BROM	CIS-1,2-DICHLOROETHYLENE		
X1CDCE	CHLOROETHANE*		
X1CHLE	CHLOROMETHANE*		
X1CHLM	CARBON TETRACHLORIDE		
X1CTET			

* - NOT DECTECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-12 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN RAW SLUDGES

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	VOLATILES		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1DCLE	1,1-DICHLOROETHENE		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1TRIC	TRICHLOROETHYLENE		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DECTECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-12 b - GLOBAL SUMMARY OF CONTAMINANTS IN RAW SLUDGES

CONTAMINANT	CONTAMINANT NAME	UNITS (DRY WEIGHT)	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL
CONVENTIONALS													
COD	CHEMICAL OXYGEN DEMAND	mg/kg	0	45	45	100.0	31	31	100.0	892221 45	3.19	2619047.62	4161 85
DOC	DISSOLVED ORGANIC CARBON	mg/kg	0	1	1	100.0	1	1	100 0	60606 06	0.00	60606.06	60606.06
NNO2FR	NITRITE,FILT REACT.	mg/kg	0	1	1	100.0	1	1	100.0	6 90	0 00	6.90	6.90
NNTKUR	NITROGEN-TOT KJEL,UNP TOT	mg/kg	0	51	51	100.0	34	34	100.0	36897 85	2.98	74829.93	24 81
PH	(-LOG(H+(CONCN))	mg/kg	0	49	49	100.0	34	34	100.0	6 03	1.10	7 32	4 73
PPUT	PHOSPHORUS,UNFILT TOTAL	mg/kg	0	42	42	100 0	28	28	100 0	20347 70	4 43	68202.08	2.23
RST	RESIDUE, TOTAL	mg/kg	0	51	51	100 0	34	34	100.0	32783 51	1 81	85800.00	6730 00
RSTLOI	RESIDUE,TOT LOSS ON IGNI.	mg/kg	0	51	51	100.0	34	34	100.0	20803 05	1.77	51591.00	4370.00
NNH'FR	AMMONIUM,TOTAL FILT REAC.	mg/kg	0	47	48	97.9	33	33	100.0	5911 32	4 59	18006 23	1097.42
NNOTFR	NITRATES,TOTAL FILT REAC.	mg/kg	0	43	48	89 6	31	33	93 9	25.44	2.21	74.77	5 96
PHNOL	PHENOLICS (4AAP)	mg/kg	0	41	50	82.0	29	34	85.3	82.34	3 54	585.11	16 32
METALS													
ALUT	ALUMINUM,UNFILT TOTAL	mg/kg	0	51	51	100.0	34	34	100.0	9835.74	2.51	102040 82	2706 77
HGUT	MERCURY,UNFILT TOTAL	ug/kg	0	50	50	100.0	33	33	100.0	2.23	1.67	8.16	0.51
CUUT	COPPER,UNFILT TOTAL	mg/kg	0	46	46	100.0	33	33	100 0	606 31	1 72	4055 88	243.54
SRUT	STRONTIUM,UNFILT.TOTAL	mg/kg	0	51	51	100.0	34	34	100.0	231.70	1 97	1206.90	36 13
ZNUT	ZINC,UNFILT TOTAL	mg/kg	0	51	51	100.0	34	34	100 0	905 39	2.39	16334 66	280 44
ASUT	ARSENIC,UNFILT.TOTAL	mg/kg	0	50	51	98.0	33	34	97.1	6.13	2.01	41.50	2.25
CRUT	CHROMIUM,UNFILT TOTAL	mg/kg	0	50	51	98 0	33	34	97.1	301 43	3.68	8235 29	44 28
PBUT	LEAD,UNFILT.TOTAL	mg/kg	0	48	49	98 0	31	32	96.9	173.99	2 24	5179 28	42 63
SEUT	SELENIUM,UNFILT TOTAL	mg/kg	0	48	50	96.0	31	33	93.9	3 04	1.93	22.90	0.93
NIUT	NICKEL,UNFILT.TOTAL	mg/kg	0	44	46	95.7	28	30	93 3	59 17	2.90	2558 82	10 54
CDUT	CADMIUM,UNFILT TOTAL	mg/kg	0	40	43	93.0	27	30	90.0	9 74	4 35	183 67	1.37
AGUT	SILVER,UNFILT TOTAL	mg/kg	0	40	45	88 9	27	32	84 4	30 17	2.61	154.14	6 90
COUT	COBALT,UNFILT TOTAL	mg/kg	0	30	41	73 2	22	30	73 3	9 29	4 69	1838 01	3.58
MOUT	MOLYBDENUM,UNFILT.TOTAL	mg/kg	0	23	37	62 2	18	28	64 3	5 80	2.88	256 41	2.32
CCNFUR	CYANIDE-FREE,UNFILT REAC.	mg/kg	0	3	40	7.5	3	30	10 0	0 02	2.74	0.48	0 23
BEUT	BERYLLIUM,UNFILT TOTAL	mg/kg	0	1	25	4 0	1	24	4 2	0 50	3 55	1.01	1 01
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS													
PMMCRE	M-CRESOL	ug/kg	1	42	51	82 3	29	34	85.3	116847.30	12.16	9649056 60	232 80
PMPHEN	PHENOL	ug/kg	2	15	51	29 4	13	34	38 2	7312 80	3 00	76491 20	13702.60
PNNAPH	NAPHTHALENE	ug/kg	1	6	51	11 8	5	34	14.7	3823 30	3.75	12653061 20	3409 20
PNPHEN	PHENANTHRENE	ug/kg	1	6	51	11 8	6	34	17.7	3563 50	2.19	24316 50	3529 70
PMBBP	BUTYL BENZYL PHTHALATE	ug/kg	1	4	51	7 8	4	34	11 8	3445.60	2 25	48701 80	17087 40
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER	ug/kg	1	2	51	3 9	2	34	5.9	3464 00	3 02	958199.40	97130.20
PNCHRY	CHRYSENE	ug/kg	1	2	51	3 9	2	34	5 9	3026 90	1 93	21549 80	6584 00
PNFLAN	FLUORANTHENE	ug/kg	1	2	51	3 9	2	34	5.9	3083 50	1 97	27878 80	8350 60
PNPYR	PYRENE	ug/kg	1	2	51	3 9	2	34	5.9	4522 60	1 87	20740.70	8039 80
PMDPE	DIPHENYL ETHER	ug/kg	1	1	51	2.0	1	34	2.9	7296.10	1 81	14788 70	14788 70
PMNTB	NITROBENZENE	ug/kg	1	1	51	2.0	1	34	2.9	3405 40	3.60	10204081 60	10204081 60
PMNND	N-NITROSO-DI-PHENYLAMINE	ug/kg	1	1	51	2 0	1	34	2.9	2972 50	1 81	8530.30	8530.30
PNACNY	ACENAPHTHYLENE	ug/kg	1	1	51	2.0	1	34	2.9	4406 70	1 83	13187 30	13187 30
PNANTH	ANTHRACENE	ug/kg	1	1	51	2.0	1	34	2.9	2919 80	1 80	5484.70	5484 70
PNBBFA	BENZO(B)FLUORANTHENE	ug/kg	1	1	51	2 0	1	34	2 9	2924 20	1 82	7811 40	7811 40

TABLE 5-12 b - GLOBAL SUMMARY OF CONTAMINANTS IN RAW SLUDGES

CONTAMINANT	CONTAMINANT NAME	UNITS (DRY WEIGHT)	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL
DIOXINS AND FURANS													
P98CDD	OCTACHLORODIBENZODIOXIN	ug/kg	1	25	50	50.0	20	34	58.8	8.50	3.60	309.10	1.30
P97CDD	HEPTACHLORODIBENZODIOXIN	ug/kg	1	6	50	12.0	6	34	17.7	7.20	4.12	14.30	1.40
P98CDF	OCTACHLORODIBENZOFURAN	ug/kg	1	4	50	8.0	4	34	11.8	5.40	3.48	31.20	1.80
P94CDF	TETRACHLORODIBENZOFURAN	ug/kg	2	3	50	6.0	3	34	8.8	2.40	2.94	25.40	5.20
P95CDF	PENTACHLORODIBENZOFURAN	ug/kg	1	1	50	2.0	1	34	2.9	3.90	3.57	2.50	2.50
P96CDF	HEXACHLORODIBENZOFURAN	ug/kg	1	1	50	2.0	1	34	2.9	5.50	4.45	3.80	3.80
P97CDF	HEPTACHLORODIBENZOFURAN	ug/kg	1	1	50	2.0	1	34	2.9	7.20	4.98	25.30	25.30
PESTICIDES,HERBICIDES,PCBS													
P1PCBT	PCB, TOTAL	ug/kg	2	40	51	78.4	27	34	79.4	88.70	3.18	2895.60	19.50
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/kg	3	38	51	74.5	28	34	82.3	93.20	6.50	3742.70	15.30
P1BHCO	GAMMA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	2	28	51	54.9	23	34	67.7	8.90	2.69	101.00	4.70
P3SILV	SILVEX	ug/kg	3	23	51	45.1	19	34	55.9	47.30	3.40	1169.60	37.00
P1PPDE	PP DDE	ug/kg	1	22	51	43.1	18	34	52.9	7.30	2.31	67.70	4.00
P3245T	2,4,5 TRICLORPHENOXYACETIC ACID	ug/kg	3	21	51	41.2	16	34	47.1	48.90	3.49	744.00	31.00
P1DIEL	DIELDRIN	ug/kg	2	20	51	39.2	17	34	50.0	7.20	3.10	259.70	5.40
P1CHLG	GAMMA CHLORDANE	ug/kg	1	19	51	37.3	17	34	50.0	6.00	2.44	36.10	2.90
P1OMDT	METHOXYCHLOR	ug/kg	1	19	51	37.3	15	34	44.1	45.80	5.15	3179.70	17.80
P1BHCB	BETA-BHC (HEXCHLORCYCLHEXANE)	ug/kg	1	18	51	35.3	13	34	38.2	7.40	3.29	111.30	2.30
P1CHLA	ALPHA CHLORDANE	ug/kg	1	18	51	35.3	16	34	47.1	5.90	2.38	34.00	2.30
X2124	1,2,4-TRICHLOROBENZENE	ug/kg	3	17	51	33.3	14	34	41.2	9.30	4.06	322.60	10.60
X2HCB	HEXACHLOROBENZENE	ug/kg	2	17	51	33.3	13	34	38.2	5.60	2.65	145.40	1.00
P1PPDD	PP DDD	ug/kg	1	13	51	25.5	12	34	35.3	5.10	2.48	101.00	2.30
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	1	12	51	23.5	12	34	35.3	5.50	2.74	53.60	2.30
P1HEPE	HEPTACHLOREPOXIDE	ug/kg	2	12	51	23.5	11	34	32.4	5.00	2.62	185.50	3.50
P1END1	ENDOSULFAN I	ug/kg	3	9	51	17.7	7	34	20.6	4.60	2.56	129.90	4.80
P1ENDR	ENDRIN	ug/kg	3	8	51	15.7	8	34	23.5	4.20	2.21	37.40	3.20
P1OCHL	OXYCHLORDANE	ug/kg	2	8	51	15.7	7	34	20.6	4.50	2.27	21.70	4.60
P1HEPT	HEPTACHLOR	ug/kg	3	7	51	13.7	7	34	20.6	4.50	2.83	101.00	1.00
P1ALDR	ALDRIN	ug/kg	1	6	51	11.8	6	34	17.7	4.60	2.50	49.80	4.30
P1END2	ENDOSULFAN II	ug/kg	3	6	51	11.8	6	34	17.7	4.20	2.38	48.20	4.80
P1ENDS	ENDOSULFAN SULPHATE	ug/kg	3	6	51	11.8	6	34	17.7	18.60	2.80	516.90	28.90
P1PPDT	PP DDT	ug/kg	3	6	51	11.8	6	34	17.7	16.40	2.27	105.30	15.90
P1BHCD	DELTA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	1	3	51	5.9	3	34	8.8	4.00	2.22	23.00	6.50
P1MIRX	MIREX	ug/kg	1	2	51	3.9	2	34	5.9	4.00	2.37	101.00	23.90
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/kg	3	2	51	3.9	2	34	5.9	35.30	2.18	90.30	44.20
VOLATILES													
B2MPXY	M-, AND P-XYLENES	ug/kg	1	16	51	31.4	14	34	41.2	1345.90	3.86	47146.40	1776.00
X1CHLO	CHLOROFORM	ug/kg	1	12	51	23.5	12	34	35.3	1225.10	4.24	95238.10	1688.30
B2EBNZ	ETHYLBENZENE	ug/kg	1	10	51	19.6	9	34	26.5	890.70	2.60	24813.90	738.40
B2OXYL	O-XYLENE	ug/kg	1	8	51	15.7	8	34	23.5	841.60	2.51	14172.00	1096.90
X1TETR	TETRACHLOROETHYLENE	ug/kg	1	3	51	5.9	3	34	8.8	661.30	1.90	3162.80	1346.80
B2STYR	STYRENE	ug/kg	1	1	51	2.0	1	34	2.9	639.40	1.96	6010.90	6010.90
X1BDCM	BROMODICHLOROMETHANE	ug/kg	1	1	51	2.0	1	34	2.9	934.60	1.82	1749.50	1749.50
X1CDBM	CHLORODIBROMOMETHANE	ug/kg	1	1	51	2.0	1	34	2.9	641.20	1.99	7312.10	7312.10
X213CB	1,3 DICHLOROBENZENE	ug/kg	1	1	51	2.0	1	34	2.9	635.50	1.91	3970.20	3970.20
X214CB	1,4 DICHLOROBENZENE	ug/kg	1	1	51	2.0	1	34	2.9	643.70	2.00	7692.30	7692.30

percent of the samples. The most frequently detected pesticide and herbicide compound was detected in 78 percent of the samples and 16 of the pesticide/herbicide compounds were detected in more than 20 percent of samples.

5.3.9 Summary of Contaminants in Treated Sludges

Table 5-13(a) presents a list of the 81 contaminants that were not detected in any treated sludge samples from any WPCP, including 5 contaminants that were not confirmed. Also indicated are the 34 contaminants not detected in any sample type at any WPCP.

Fifteen metals and 64 organic compounds were detected in at least one treated sludge sample. Table 5-13(b) summarizes the contaminants detected in treated sludges. The most prevalent organic compounds were the pesticides and herbicides, with 10 compounds detected at more than 40 percent of the plants. The most prevalent base neutral and acid extractable and volatile compounds were detected at fewer than 35 percent of plants. One dioxin compound (Octachlorodibenzodioxin) was detected at 65 percent of the plants. There were 13 metals detected at more than 86 percent of the plants and 6 (Ag, Al, Cr, Cu, Sr and Zn) detected at all of the plants.

The most frequently detected contaminants were metals, with 13 metals detected in at least 82 percent of samples, and 6 detected in all the samples. None of the base neutral and acid extractable, or volatile compounds were detected in more than 30 percent of samples. One dioxin compound was detected in 53 percent of samples, and the remaining dioxins were detected in less than 20 percent. The most frequently detected pesticide and herbicide compound was detected in 68 percent of samples, and 16 of the pesticide/herbicide compounds were detected in more than 20 percent of the samples.

5.3.10 Summary of Contaminants Detected in Any Sample Type

Table 5-14 presents a summary of contaminants detected in any sample type. The Table provides for each of the five contaminant groups, the number of compounds detected, the maximum percentage prevalency (ie. the maximum percentage of all WPCPs in which the contaminant was identified) for any contaminant in the group and the maximum percentage frequency (ie. the maximum percentage of all samples of a given type in which the contaminant was identified) for any contaminant in the group.

As noted throughout Section 5.3 metals were the most prevalently (most WPCPs) and most frequently detected contaminants in all sample types.

TABLE 5-13 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN TREATED SLUDGES

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	METALS AND CYANIDE		
CCNFUR	CYANIDE-FREE,UNFILT.REAC.		
	BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS		
		PMPCRE	P-CRESOL*
P2AMET	AMETRYNE		
P2ATRA	ATRAZINE*		
P4DIAZ	DIAZINON*		
P4EPAR	PARATHION ETHYL*		
P4MALA	MALATHION*		
P4MPAR	METHYLPARATHION*		
PM24DP	2,4-DICHLOROPHENOL		
PM24DT	2,4-DINITROTOLUENE		
PM24MP	2,4-DIMETHYLPHENOL		
PM24NP	2,4-DINITROPHENOL*		
PM26DT	2,6-DINITROTOLUENE		
PM2NP	2-NITROPHENOL		
PM46DP	2-METHYL4,6-DINITROPHENOL		
PM4BPE	4-BROMOPHENYLPHENYLETHER		
PM4CPE	4-CHLOROPHENYLPHENYLETHER		
PM4NP	4-NITROPHENOL		
PMANAA	ALPHA-NAPHTHYLAMINE*		
PMB2EM	BIS(2-CHLORETHOXY)METHANE		
PMB2IE	BIS(2-CHLOROISOPROPYL)ETHER		
PMB2NE	BIS-(2-CHLOROMETHYL)ETHER		
PMBNAA	BETA-NAPHTHYLAMINE*		
PMDMP	DIMETHYL PHTHALATE		
PMOCRE	O-CRESOL		
PMPCMC	P-CHLORO-M-CRESOL		
PN2CNA	CHLORONAPHTHALENE*		
PNACNE	ACENAPHTHENE*		
PNBBFA	BENZO(B)FLUORANTHENE		
PNDAHA	DIBENZO(A,H)ANTHRACENE*		
PNGHIP	BENZO(G,H,I)PERYLENE*		
PNINP	IDENO(1,2,3-CD)PYRENE*		
PODICH	DICHLORAN*		
POTOC	TRI-O-CRESYL PHOSPHATE*		
X30010	2-CHLOROPHENOL		
X3245	2,4,5-TRICHLOROPHENOL*		
X3246	2,4,6-TRICHLOROPHENOL		
X3PCPH	PENTACHLOROPHENOL		
	DIOXINS AND FURANS		
P94CDD	TETRACHLORODIBENZODIOXIN*		
P94CDF	TETRACHLORODIBENZOFURAN		
P96CDF	HEXACHLORODIBENZOFURAN		
P97CDF	HEPTACHLORODIBENZOFURAN		
P98CDF	OCTACHLORODIBENZOFURAN		
	PESTICIDES, HERBICIDES, PCBS		
P1ENDA	ELDRIN ALDEHYDE	POCAPN	CAPTAN*
P1STRO	STROBANE*	X1HCBD	HEXACHLOROBUTADIENE*
P1TOX	TOXAPHENE		
	VOLATILES		
B1OCTE	1-OCTENE	X1ACRO	ACROLEIN
B1VBR	VINYL BROMIDE*	X1ACRY	ACRYLONITRILE*
B2BDCL	BROMODICHLOROBENZENE		
B2STYR	STYRENE		
E1DIEE	DIETHYL ETHER		
PM2CEE	2-CHLOROETHYLVINYLETHER*		
X11122	1,1,2,2-TETRACHLOROETHANE*		
X1112T	1,1,2-TRICHLOROETHANE*		
X111CE	1,1-DICHLOROETHANE		
X112CE	1,2-DICHLOROETHANE		
X112CP	1,2-DICHLOROPROPANE		
X113DP	CIS-1,3-DICHLOROPROPENE		
X113DR	TRANS-1,3-DICHLOROPROPENE		
X1ACTO	ALPHA-CHLOROTOLUENE		
X1BDCM	BROMODICHLOROMETHANE		
X1BETH	BROMOETHANE*		
X1BROM	BROMOFORM*		
X1CDCE	CIS-1,2-DICHLOROETHYLENE		
X1CHLE	CHLOROETHANE*		
X1CHLM	CHLOROMETHANE*		
X1CTET	CARBON TETRACHLORIDE		
X1DCFM	DICHLORODIFLUOROMETHANE		
X1DCLE	1,1-DICHLOROETHENE		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-13 a - GLOBAL SUMMARY OF CONTAMINANTS NOT DETECTED IN TREATED SLUDGES

CONFIRMED		NOT CONFIRMED	
CONTAMINANT CODE	CONTAMINANT NAME	CONTAMINANT CODE	CONTAMINANT NAME
	VOLATILES		
X1T12D	TRI-1,2-DICHLOROETHYLENE*		
X1TCFM	TRICHLOROFLUOROMETHANE*		
X1VCL	VINYL CHLORIDE*		
X212CB	1,2-DICHLOROBENZENE		
X213CB	1,3-DICHLOROBENZENE		
X23CTO	3-CHLOROTOLUENE		
X2CBEN	CHLOROBENZENE		
X2CPPE	3-CHLOROPROPENE*		

* - NOT DETECTED IN ANY STREAM TYPE AT ANY PLANT

TABLE 5-13b - GLOBAL SUMMARY OF CONTAMINANTS IN TREATED SLUDGES

CONTAM-INANT	CONTAMINANT NAME	UNITS (DRY WEIGHT)	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL
CONVENTIONALS													
COD	CHEMICAL OXYGEN DEMAND	mg/kg	0	36	36	100.0	29	29	100.0	508097.94	4.65	2483375.96	2760.08
NNHTFR	AMMONIUM,TOTAL,FILT REAC.	mg/kg	0	25	25	100.0	19	19	100.0	17658.28	2.92	269683.26	1419.58
NNTKUR	NITROGEN-TOT-KJEL,UNF TOT	mg/kg	0	49	49	100.0	34	34	100.0	38494.12	1.77	294117.65	14400.02
PH	(-LOG(H+(CONCN))	mg/kg	0	47	47	100.0	34	34	100.0	7.17	1.09	9.84	5.70
PPUT	PHOSPHORUS,UNFILT TOTAL	mg/kg	0	43	43	100.0	29	29	100.0	76638.67	6.91	16094159.99	19410.00
RST	RESIDUE, TOTAL	mg/kg	0	50	50	100.0	34	34	100.0	80434.04	3.23	479900.00	2210.00
RSTLOI	RESIDUE,TOT LOSS ON IGNI.	mg/kg	0	50	50	100.0	34	34	100.0	43379.33	3.19	240560.00	1180.00
NNOTFR	NITRATES,TOTAL,FILT REAC.	mg/kg	0	23	26	88.5	19	20	95.0	42.68	2.29	565.61	9.24
PHNOL	PHENOLICS (4AAP)	mg/kg	0	41	49	83.7	29	33	87.9	43.05	3.14	1062.50	6.80
METALS													
AGUT	SILVER,UNFILT TOTAL	mg/kg	0	44	44	100.0	30	30	100.0	37.78	2.33	240.73	2.30
ALUT	ALUMINUM,UNFILT TOTAL	mg/kg	0	50	50	100.0	34	34	100.0	10715.94	2.82	81967.21	391.42
CRUT	CHROMIUM,UNFILT TOTAL	mg/kg	0	50	50	100.0	34	34	100.0	333.06	3.59	7488.15	5.45
CUUT	COPPER,UNFILT TOTAL	mg/kg	0	45	45	100.0	33	33	100.0	732.24	2.16	4962.09	58.24
SRUT	STRONTIUM,UNFILT TOTAL	mg/kg	0	50	50	100.0	34	34	100.0	240.93	2.54	1366.46	6.25
ZNUT	ZINC,UNFILT TOTAL	mg/kg	0	50	50	100.0	34	34	100.0	988.90	2.57	15126.05	52.05
ASUT	ARSENIC,UNFILT TOTAL	mg/kg	0	49	50	98.0	33	34	97.1	5.40	2.06	23.56	0.43
HGUT	MERCURY,UNFILT TOTAL	ug/kg	0	49	50	98.0	33	34	97.1	3.24	2.04	33.74	0.77
PBUT	LEAD,UNFILT TOTAL	mg/kg	0	49	50	98.0	33	34	97.1	196.62	2.46	4537.82	10.23
SEUT	SELENIUM,UNFILT TOTAL	mg/kg	0	48	50	96.0	33	34	97.1	2.67	2.98	22.49	0.10
NIUT	NICKEL,UNFILT TOTAL	mg/kg	0	42	45	93.3	27	30	90.0	72.95	2.95	2393.36	6.26
CDUT	CADMIUM,UNFILT TOTAL	mg/kg	0	41	45	91.1	28	31	90.3	10.47	3.98	175.64	1.73
COUT	COBALT,UNFILT TOTAL	mg/kg	0	32	39	82.1	24	28	85.7	9.14	2.75	38.35	2.34
MOUT	MOLYBDENUM,UNFILT TOTAL	mg/kg	0	23	34	67.7	18	26	69.2	6.41	2.84	83.33	1.32
BEUT	BERYLLIUM,UNFILT TOTAL	mg/kg	0	1	26	3.9	1	24	4.2	0.47	3.32	0.63	0.63
BASE NEUTRAL AND ACID EXTRACTABLE COMPOUNDS													
PMMCRE	M CRESOL	ug/kg	1	15	50	30.0	12	34	35.3	5281.80	8.20	2211895.90	7750.00
PNPHEN	PHENANTHRENE	ug/kg	1	12	50	24.0	9	34	26.5	2220.50	4.27	28235.30	2868.50
PMBBP	BUTYLBENZYLPHTHALATE	ug/kg	1	8	50	16.0	6	34	17.7	1916.90	5.23	914498.10	1673.60
PNNAPH	NAPHTHALENE	ug/kg	1	6	50	12.0	5	34	14.7	1545.60	3.77	25585.80	2389.10
PNCHRY	CHRYSENE	ug/kg	1	4	50	8.0	4	34	11.8	1475.50	3.39	13852.20	971.00
PNFLAN	FLUORANTHENE	ug/kg	1	4	50	8.0	3	34	8.8	1338.90	4.26	22097.60	8.20
PMNITB	NITROBENZENE	ug/kg	1	3	50	6.0	3	34	8.8	1405.80	3.46	17400.90	6398.20
PMPHEN	PHENOL	ug/kg	2	3	50	6.0	3	34	8.8	2108.80	3.65	31126.40	15558.70
PNFLUO	FLUORENE	ug/kg	1	3	50	6.0	3	34	8.8	1352.10	3.25	4947.20	2601.70
PNPYR	PYRENE	ug/kg	1	3	50	6.0	3	34	8.8	2124.30	3.44	18799.50	9243.70
PMDPE	DIPHENYL ETHER	ug/kg	1	2	50	4.0	2	34	5.9	3222.10	3.37	30000.00	15083.70
PNBAA	BENZO(A)ANTHRACENE	ug/kg	1	2	50	4.0	2	34	5.9	1379.50	3.41	14511.90	6666.70
PMNND	N-NITROSO-DI PHENYLAMINE	ug/kg	1	1	50	2.0	1	34	2.9	1276.20	3.35	12471.40	12471.40
PMNNP	N-NITROSO DI NPROPYLAMINE	ug/kg	1	1	50	2.0	1	34	2.9	1335.60	3.39	17475.70	17475.70
PNACNY	ACENAPHTHYLENE	ug/kg	1	1	50	2.0	1	34	2.9	1909.40	3.26	6142.90	6142.90
PNANTH	ANTHRACENE	ug/kg	1	1	50	2.0	1	34	2.9	1306.60	3.21	3957.80	3957.80
PNBAP	BENZO(A)PYRENE	ug/kg	1	1	50	2.0	1	34	2.9	1333.30	3.30	10883.90	10883.90
PNBIPH	BIPHENYL	ug/kg	1	1	50	2.0	1	34	2.9	1890.80	3.26	6255.20	6255.20
PNBKF	BENZO(K)FLUORANTHENE	ug/kg	1	1	50	2.0	1	34	2.9	1350.20	3.39	20448.50	20448.50

TABLE 5-13b - GLOBAL SUMMARY OF CONTAMINANTS IN TREATED SLUDGES

CONTAM-INANT	CONTAMINANT NAME	UNITS (DRY WEIGHT)	QA/QC CODE	GLOBAL # SAMPS. DET.	GLOBAL # SAMPS. TESTED	GLOBAL % FREQ. DET.	GLOBAL # PLANTS DET.	GLOBAL # PLANTS	GLOBAL % PLANT PREV.	GLOBAL GEO. MEAN	GLOBAL SPREAD FACTOR	GLOBAL MAX. CONC.	GLOBAL MIN. CONC. > DL
DIOXINS AND FURANS													
P98CDD	OCTACHLORODIBENZODIOXIN	ug/kg	1	26	49	53.1	22	34	64.7	7.10	3.84	303.60	0.60
P97CDD	HEPTACHLORODIBENZODIOXIN	ug/kg	1	10	49	20.4	8	34	23.5	5.00	3.21	72.60	1.40
P96CDD	HEXACHLORODIBENZODIOXIN	ug/kg	2	2	49	4.1	2	34	5.9	2.40	3.52	3.80	1.10
P95CDD	PENTACHLORODIBENZODIOXIN	ug/kg	2	1	49	2.0	1	34	2.9	3.20	6.14	1.30	1.30
P95CDP	PENTACHLORODIBENZOFURAN	ug/kg	1	1	49	2.0	1	34	2.9	2.50	5.12	1.60	1.60
PESTICIDES,HERBICIDES,PCBS													
P1PPDE	PP-DDE	ug/kg	1	34	50	68.0	25	34	73.5	11.10	2.72	164.80	3.60
P1PCBT	PCB, TOTAL	ug/kg	2	32	50	64.0	23	34	67.7	114.10	4.58	5592.10	34.10
P324D	2,4-DICHLOROPHENOXYACETIC ACID	ug/kg	3	25	50	50.0	22	34	64.7	75.00	5.81	2792.70	11.30
P1CHLA	ALPHA-CHLORDANE	ug/kg	1	22	50	44.0	19	34	55.9	6.50	2.41	36.50	4.20
X2124	1,2,4-TRICHLOROBENZENE	ug/kg	3	22	50	44.0	18	34	52.9	14.80	5.02	784.70	12.90
P1CHLG	GAMMA-CHLORDANE	ug/kg	1	21	50	42.0	18	34	52.9	6.80	2.58	38.00	4.90
X2HCB	HEXACHLOROBENZENE	ug/kg	2	21	50	42.0	19	34	55.9	7.00	2.96	123.70	1.10
P1BHCB	BETA-BHC (HEXCHLORCYCLHEXANE)	ug/kg	1	19	50	38.0	16	34	47.1	8.80	4.39	621.70	3.20
P3SILV	SILVEX	ug/kg	3	18	50	36.0	15	34	44.1	92.70	2.94	1264.80	16.80
P3245T	2,4,5-TRICLORPHENOXYACETIC ACID	ug/kg	3	16	50	32.0	14	34	41.2	84.40	3.13	1443.30	28.10
P1DIEL	DIELDRIN	ug/kg	2	15	50	30.0	13	34	38.2	6.50	3.51	384.20	5.80
P1DMDT	METHOXYCHLOR	ug/kg	1	15	50	30.0	13	34	38.2	34.10	4.42	7633.60	21.20
P1BHCG	GAMMA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	2	12	50	24.0	12	34	35.3	5.70	3.13	107.40	5.00
P1ALDR	ALDRIN	ug/kg	1	11	50	22.0	9	34	26.5	5.30	2.67	77.60	9.60
P1BHCA	ALPHA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	1	11	50	22.0	11	34	32.4	5.60	3.00	77.80	4.20
P1HEPE	HEPTACHLOREPOXIDE	ug/kg	2	10	50	20.0	8	34	23.5	5.20	2.86	242.70	4.90
P1HEPT	HEPTACHLOR	ug/kg	3	9	50	18.0	8	34	23.5	4.70	2.20	28.10	6.80
P1MIRX	MIREX	ug/kg	1	8	50	16.0	6	34	17.7	4.90	2.52	80.80	7.90
X1HCCP	HEXACHLOROCYCLOPENTADIENE	ug/kg	3	8	50	16.0	8	34	23.5	34.20	2.76	639.70	27.60
P1END2	ENDOSULFAN II	ug/kg	3	7	50	14.0	7	34	20.6	4.70	2.67	81.30	12.30
P1PPDD	PP-DDD	ug/kg	1	7	50	14.0	7	34	20.6	4.60	2.47	68.20	8.10
P1END1	ENDOSULFAN I	ug/kg	3	6	50	12.0	4	34	11.8	4.90	2.96	113.60	12.10
P1ENDS	ENDOSULFAN SULPHATE	ug/kg	3	6	50	12.0	6	34	17.7	17.50	2.53	362.60	35.20
P1OCHL	OXYCHLORDANE	ug/kg	2	6	50	12.0	6	34	17.7	4.20	2.24	26.70	8.10
P1ENDR	ENDRIN	ug/kg	3	5	50	10.0	5	34	14.7	4.20	2.36	56.80	4.70
P1PPDT	PP-DDT	ug/kg	3	5	50	10.0	5	34	14.7	16.70	2.14	181.80	24.30
P0PCNB	PCNB	ug/kg	2	2	22	9.1	2	14	14.3	22.60	1.51	62.70	60.00
P1BHCD	DELTA-BHC(HEXCHLORCYCLHEXANE)	ug/kg	1	4	50	8.0	4	34	11.8	3.90	1.93	11.50	2.50
P1PMIR	MIREX PHOTO	ug/kg	2	2	50	4.0	2	34	5.9	3.90	2.25	85.40	16.00
X2HCE	HEXACHLOROETHANE	ug/kg	3	1	50	2.0	1	34	2.9	3.70	1.94	11.50	11.50
VOLATILES													
B2MPXY	M-, AND P XYLENES	ug/kg	1	15	50	30.0	11	34	32.4	816.00	7.11	1416961.90	626.60
B2EBNZ	ETHYLBENZENE	ug/kg	1	14	50	28.0	11	34	32.4	606.50	5.59	500104.20	181.40
B2OXYL	O XYLENE	ug/kg	1	14	50	28.0	11	34	32.4	523.50	4.05	37037.00	268.40
X1CHLO	CHLOROFORM	ug/kg	1	12	50	24.0	12	34	35.3	441.70	4.33	12937.10	7.60
X1TETR	TETRACHLOROETHYLENE	ug/kg	1	2	50	4.0	2	34	5.9	285.40	3.51	3359.40	2839.50
X214CB	1,4 DICHLOROBENZENE	ug/kg	1	2	50	4.0	2	34	5.9	272.70	3.28	2643.70	220.00
L1HEX	HEXANOL	ug/kg	2	1	50	2.0	1	34	2.9	11979.20	14.28	143678.20	143678.20
X111IT	1,1,1-TRICHLOROETHANE	ug/kg	1	1	50	2.0	1	34	2.9	254.90	3.34	2323.20	2323.20
X1CDBM	CHLORODIBROMOMETHANE	ug/kg	1	1	50	2.0	1	34	2.9	264.10	3.53	6634.30	6634.30
X1TRIC	TRICHLOROETHYLENE	ug/kg	1	1	50	2.0	1	34	2.9	261.30	3.24	937.50	937.50

Table 5-14

SUMMARY OF CONTAMINANTS DETECTED IN ANY SAMPLE TYPE

			Metals and Cyanide			Base Neutral and Acid Extractable			Dioxin/Furan (2)			Pesticides and Herbicides			Volatiles		
Sample Type	No. Plants	No. Samples (1)	No. Det. (3)	Max % Plant Prev.	Max % Freq. Det.	No. Det. (3)	Max % Plant Prev.	Max % Freq. Det.	No. Det. (3)	Max % Plant Prev.	Max % Freq. Det.	No. Det. (3)	Max % Plant Prev.	Max % Freq. Det.	No. Det. (3)	Max % Plant Prev.	Max % Freq. Det.
Raw Sewage	37	275	15	100	99.7	31	86.5	60.7	3	10.8	7.4	29	100	77.5	22	37.8	15.7
Primary Effluent	7	39	14	100	100	6	71.4	46.2	2	26.8	25.0	16	85.7	72.5	12	85.7	55.3
Lagoon Effluent (4)	2	12	10	100	100	0	-	-	0	-	-	7	100	100	0	-	-
Secondary Effluent	28	224	15	100	100	24	14.3	3.1	4	14.3	9.1	24	100	78.0	19	64.3	16.5
Tertiary Effluent (4)	1	10	13	100	100	15	100	30.0	0	-	-	8	100	90.0	9	100	50.0
Raw Sludge (2)	34	51	16	100	100	15	85.3	82.3	7	58.5	50.0	27	79.4	78.4	10	41.2	31.4
Treated Sludge (2)	34	50	15	100	100	19	35.3	30.0	5	64.7	53.1	30	73.5	68.0	10	32.4	30.0

Notes:

(1) The number of samples may vary depending on compound group. The number given is representative of most compound groups. Refer to Table 5-4(a) - 5-10(a) for exact numbers.

(2) Samples are 5-day composites.

(3) The number of contaminants detected in the sample type.

(4) Summary data for lagoon and tertiary effluents is included for the sake of completeness. Due to the small number of facilities sampled, this data should be interpreted with caution.

(KIR18/285W)

Only 5 base neutral and acid extractable compounds (M-cresol, Phenol, Phenanthrene, Butylbenzl phthalate and Naphthalene) were detected at more than 20% of the plants studied for any sample type. With the exception of the 5 compounds, base neutral and acid extractable compounds were detected at a maximum of 14 percent of plants and in a maximum of 8 percent of samples, for all sample types. Interestingly, the maximum prevalency and frequency of detection of base/neutral acid extractable compounds in all secondary effluent samples was substantially smaller than in the raw sewage, primary effluent or sludge sample types.

The maximum frequency of detection and prevalency of dioxins and furans was relatively low in raw sewage and in primary and secondary effluent streams. In contrast, the number of dioxin/furan compounds detected, and the maximum frequency of detection and prevalency were markedly greater in sludge streams.

Approximately the same number of compounds in the pesticide/herbicide group were detected in raw sewage, secondary effluent and raw treated sludge streams. About 50 percent fewer compounds were detected in primary effluents. This may be attributable to a lower number of primary plants monitored. The maximum frequency of detection and prevalency is quite large and reasonably uniform for all sample types.

The largest number of volatile compounds were detected in the raw sewage and secondary effleunt streams. Maximum frequency of detection and prevalency were quite variable among the sample types ranging from 32 percent to 85 percent prevalency and 15 percent to 55 percent frequency of detection.

6.0 SUMMARY

This interim report on the WPCP Pilot Monitoring Study was prepared to present the study program methodology and the analytical data in conjunction with the QA/QC results. Also included are the individual plant information summaries (Appendix A).

The final report will present a more detailed review and analysis of the study results. More specifically, the report will include the following:

- An assessment of the impact of industrial, residential and sanitary sewer inputs on the nature and loadings of HCs observed in the raw wastewaters and sludges.
- An estimate of HC loadings discharged in the sludges and liquid effluents of the 37 WPCPs.
- An assessment of the ability of WPCPs to remove HCs and identification of the factors affecting HC removal efficiency.
- A prioritized list of contaminants observed at the 37 WPCPs.
- The major concerns affecting the implementation of the monitoring regulation and recommendations to address problem areas.

7.0 REFERENCES

1. Ontario Ministry of the Environment (1988). "The Effluent Monitoring Priority Pollutants List (1987)", Ontario MOE, Hazardous Contaminants Coordination Branch, Toronto, Ontario. (ISBN 0-7729-0784-7).

2. U.S. EPA (1984). "Development Document for Effluent Limitations Guidelines and Standards for the Plastics Moulding and Forming Point Sauce Category". U.S. EPA, Office of Water Regulations and Standards, Industrial Technology Division, Washington, D.C. (EPA-440-/1-84-069).

3. Zenon Environmental Inc. "Joint MOE/Environment Canada/MEA Municipal Sewage Treatment Plants Pilot Monitoring Project Volume 1 - Final Report" January 1988. Prepared for Ontario Ministry of the Environment.

4. Survey of Industrial Discharges to 37 WPCPs (1987), Ministry of the Environment Internal Report.

5. Ontario Ministry of the Environment (1988). "Estimation of Analytical Detection Limits", MISA Report. Ontario MOE, Toronto, Canada. (ISBN 0-7729, 0784-7).

6. Ontario Ministry of the Environment, LCS-QA/QC Section, Laboratory Services Branch (1988). "QA/QC Report on the Spiked Effluent and Sewage Samples from the 40 Sewage Treatment Plants Toxic Survey Project".